WAUKEGAN PARK DISTRICT: AN EVALUATION OF OFFSITE ASBESTOS AND AIR POLLUTANTS AND THEIR POTENTIAL EFFECT ON VISITORS TO THE PROPOSED SPORTS COMPLEX IN WAUKEGAN, ILLINOIS

Prepared by:

D. Wayne Berman, Ph.D.
Aeolus, Inc.
751 Taft St.
Albany, CA 94706

and

Jay Norco
Curtis Wagner
David Bottimore
David Johnson
VERSAR, INC.
200 West 22nd St., Suite 250
Lombard, IL 60148

Prepared for:

The Waukegan Park District
2000 Belevidere St.
Waukegan, IL 60085-6172

March 7, 2002

Table of Contents

Table of Contents (cont.)

LIST OF TABLES

LIST OF FIGURES

1. EXECUTIVE SUMMARY

The Waukegan Park District (WPD) is considering the purchase of a portion of the former Johns Manville (JM) asbestos products manufacturing facility in Waukegan, Illinois. The subject parcel of approximately 100 acres is the western portion of the JM site, where the manufacturing buildings where formerly located. The eastern portion of the site, which will remain with JM, is a closed National Priorities List (NPL) landfill (the JM Disposal Area NPL Site) that contains asbestos and other wastes from the former manufacturing processes. The WPD plans to develop the western portion of the JM site as a sports complex that will include facilities primarily for soccer, baseball/softball, and other recreational amenities.

This study was prompted in part by public concerns over asbestos debris found in the area and air emissions from stacks on the Midwest Generation station located immediately south of the proposed sports complex. Therefore, both in response to public concerns and WPD recognition of the need to address health-related issues before moving forward, this study was undertaken as a component of due diligence for the sports complex project.

To address concerns involving the health and welfare of future park users, the WPD retained the services of Versar, Inc. and Aeolus, Inc. to evaluate the suitability of the site from an environmental perspective. The work was then divided into three stages. This first-stage report addresses concerns associated with potential onsite effects from airborne pollutants and asbestos released from offsite sources in the vicinity of the proposed sports complex. A second stage report will address the adequacy of steps taken by JM to remove or isolate contaminants in onsite sources. A third stage report will address requirements for long-term monitoring and site maintenance. The second and third stage reports will be developed as soon as prerequisite work at the site is completed.

This Stage One analysis was completed in four steps:

1. potential sources of asbestos and air pollutants in the general vicinity of the proposed sports complex were identified;

2. available data was collected to characterize the range of chemicals handled at each source and the nature and rate of their emissions. For asbestos sources, a field investigation was conducted to characterize levels of asbestos in various surface and subsurface matrices;

3. emission and dispersion modeling was conducted to derive estimates of the concentrations of each pollutant of concern to which users of the proposed sports complex might become exposed; and

4. health effects potentially attributable to exposure to air pollutants at the proposed sports complex were evaluated by comparing predicted exposure concentrations to relevant government standards or, in their absence, other health-related criteria that were applied using government approved methodologies.

Due to differences in the manner in which they are regulated, criteria pollutants (air pollutants for which the Federal Government has developed air quality standards), non-criteria pollutants (air pollutants for which the government has not developed standards), and asbestos were separately evaluated.

The criteria pollutant evaluation consisted of several levels of analysis in which the number of sources, models, area investigated, and the meteorology employed were continually increased in resolution. In the initial (screening level) investigation, simple but conservative (worst case) assumptions are incorporated to identify pollutants that can potentially exceed corresponding health standards or criteria. Then, if no pollutants are identified that potentially exceed corresponding standards or criteria in the screening level analysis, adequate protection of public health is assured without the need to conduct additional, more sophisticated and expensive, analyses. This approach is generally less time consuming and more cost-effective than conducting full-blown analyses at the outset.

When the results of a Level I (screening) analysis showed the potential that criteria pollutants could adversely impact the proposed sports complex, the analysis was expanded to a Level II and, ultimately, a level III, with each level incorporating a greater number of potential sources, increased use of site-specific data rather than default values, and increasingly sophisticated dispersion modeling.

Results from the completed analysis of criteria pollutants show that neither short-term nor long-term carbon monoxide (CO), particulate matter (PM_{10}), Lead (Pb), and sulfur dioxide (SO_2) concentrations, when combined with their corresponding background concentrations, are likely to exceed their corresponding National Ambient Air Quality Standard (NAAQS). Thus, these criteria pollutants should not pose a risk to users at the site.

Annual nitrogen dioxide (NO_2) concentrations were also found to be in compliance with the corresponding NAAQS. Our modeling did indicate that short-term NO_2 concentrations might exceed a California standard (which was employed because no short-term Federal standard exists for NO_2). However, modeling further indicated that the likelihood that the predicted exceedances will occur in the future is extremely remote and, even if they do occur, they would not contribute unacceptably to increased risk for future park users.

For the evaluation of non-criteria pollutants, established exposure and risk assessment procedures and an EPA-approved air dispersion model were used to evaluate the potential inhalation hazards attributable to emissions of chemicals from 20 facilities that were identified within a 5 mile radius of the location of the proposed sports complex.

Risks were evaluated by: (1) collecting emissions inventory data to identify chemicals emitted by nearby facilities and estimating emission rates; (2) modeling air dispersion from identified sources to the location of the sports complex to estimate airborne exposure concentrations; and (3) assessing potential acute and chronic risks to children who may be exposed, based on data on toxic effects available for each chemical considered. Note that, by evaluating potential effects in children, adult users of the proposed sports complex are expected to have been adequately addressed by default.

Results from the analysis of non-criteria pollutants indicate that (with one exception) none of the non-criteria pollutants emitted from facilities within a five-mile radius of the proposed sports complex pose an unacceptable risk to future users of the complex for acute effects, chronic (non-cancer) effects, or cancer. Regarding the one exception, based on the current analysis, it is not possible to assure that acrolein emitted from the OMC/Bombardier facility will not pose an unacceptable, acute hazard to users of the proposed sports complex. However, before a final determination is made concerning such emissions, it is strongly recommended that emission estimates from these facilities be reevaluated. If the emissions are confirmed to be accurate, then a more sophisticated (Level III) analysis should be performed to determine whether emissions from this facility may in fact contribute unacceptably to acute hazards at the proposed sports complex.

To evaluate asbestos, a field investigation was first conducted to identify surface features and near surface features in the vicinity of the site that contain asbestos and to establish a rough indication of the nature and concentrations of asbestos identified in such features. Results from this evaluation were next combined with appropriate emission and dispersion models to provide estimates of airborne asbestos concentrations that might develop at the location of the proposed sports complex due to releases from the various asbestos-containing features investigated. Finally, estimated asbestos concentrations from measurement and modeling were compared with target acceptable exposure concentrations to assess potential health consequences for users who might visit the proposed sports complex.

Note, because lead in soil was also identified as a concern in some of these areas, samples collected for asbestos analysis were also analyzed for the determination of lead and lead results were compared with regulatory standards for lead in industrial and residential soils. Results from comparing observed lead concentrations with corresponding standards indicate that lead does not pose an unacceptable risk to future users of the proposed sports complex.

Several results from the field investigation for asbestos are worth noting. For example, results indicate that several types of asbestos were found and that observed concentrations varied widely.

Results from modeling release and transport of asbestos indicate that, with only a few exceptions, the asbestos present in the matrices sampled do not pose an unacceptable risk to future users of the proposed sports complex. Moreover, for all but one of these exceptions, the projected risks are hypothetical and would occur in the future only if certain changes occur at the site.

For the few cases in which asbestos may potentially pose an unacceptable risk, simple engineering fixes can be applied:

- asbestos currently found in the shoulders of Greenwood Ave. can potentially be introduced to the air due to vehicular traffic or wind entrainment in sufficient concentrations to pose a hazard to future users of the sports complex. It is therefore recommended that the entire right-of-way for Greenwood Ave. (east of Pershing Ave.) be paved/covered;

- hypothetically, asbestos in the deeper-strata of the roads on the JM Disposal Area NPL Site and the JM Borrow Area, if brought to the surface and released to the air due to vehicular traffic, could pose an unacceptable hazard to future sports complex users. It is therefore recommended that the clean, shallow surfacing material on these roads be maintained in good repair; and

- hypothetically, projected concentrations of asbestos in the sediments of the industrial canal and pumping lagoon, if such sediments were to become exposed and dry out, might be released to the air due to wind entrainment at sufficient concentrations to pose an unacceptable risk to future sports complex users. It is therefore recommended that water in the canal and lagoon be maintained at present levels. Note that, if there is a need to drain either of these water bodies in the future, it is recommended that sediments first be sampled to determine whether protective measures will be required to protect the public from any asbestos that may actually be present in these materials. At this time, there is no proof that asbestos exists within these sediments because they were not sampled.

2. INTRODUCTION

The Waukegan Park District (WPD) is considering the purchase of a portion of the former Johns Manville (JM) asbestos products manufacturing facility in Waukegan, Illinois. The subject parcel of approximately 100 acres is the western portion of the JM site, where the manufacturing buildings where formerly located. The eastern portion of the site, which will remain with JM, is a closed National Priorities List (NPL) landfill (the JM Disposal Area NPL Site) that contains asbestos and other wastes from the former manufacturing processes. The WPD plans to develop the western portion of the JM site as a sports complex that will include facilities for soccer, baseball/softball, and other recreational amenities.

This study was prompted in part by public concerns over asbestos debris found in the area and air emissions from stacks on the Midwest Generation station located immediately south of the proposed sports complex. Therefore, both in response to public concerns and WPD recognition of the need to address health-related issues before moving forward, this study was undertaken as a component of due diligence for the sports complex project.

A major concern of the WPD in considering the site is the health and welfare of future park users, especially children. To address this concern, the WPD retained the services of Versar, Inc. and Aeolus, Inc. (the technical team) to evaluate the suitability of the site from an environmental perspective. After reviewing various background documents and consulting with the WPD and its attorneys, the technical team developed a scope of work to identify and evaluate potential environmental concerns. The scope covered four primary areas of investigation:

1. the potential for park users to be exposed to unacceptable air quality due to air pollutant emissions from industrial facilities in the surrounding area;

2. the potential for exposure to airborne asbestos released from asbestos-containing debris that may have been deposited on (or migrated to) areas beyond the boundaries of the proposed sports complex site;

3. evaluation and verification that the remedial plan to be implemented by JM prior to transfer of land to the WPD will meet prescribed cleanup objectives; and

4. identification and evaluation of long-term monitoring and site maintenance requirements to assure continued protection of public health.

This is the first of a three-stage health and environmental review of the anticipated conditions at the proposed sports complex. This Stage One report addresses the first two of the above-listed objectives (i.e. potential onsite effects of airborne pollutants and asbestos released from offsite sources in the vicinity of the proposed sports complex).

The second stage of the study will address health and environmental issues associated with anticipated conditions at the sports complex itself, including especially those associated with the adequacy of proposed site remediation by JM. The Stage Two report will be prepared once remediation of the site is completed and plans for site preparation and development are finalized.

The third stage of the study will address long-term monitoring and site maintenance procedures that will be required to assure continued protection of public health. The Stage 3 report will be prepared once plans for development of the site are finalized.

This Stage One analysis was completed in four steps.

- First, potential sources of airborne pollutants within a five-mile radius of the proposed sports complex were identified. Sources identified include (1) industrial facilities that emit combustion products or other potentially hazardous chemicals in association with facility operations and (2) exposed soils or other matrices in the area that are known or suspected to contain asbestos debris.

Note that both point sources (e.g. stacks or other exhaust vents from defined operations) and fugitive sources (e.g. wind entrained particulate matter released from unpaved, un-vegetated land or released due to vehicular traffic on unpaved surfaces) are considered. Emissions from point sources are frequently regulated and controlled. Releases from fugitive sources are not as frequently regulated and are generally more difficult to control;

- second, available data were collected to characterize the range of chemicals associated with each source and the nature and rate of their emissions. For asbestos sources, a field investigation was conducted both to confirm the presence of asbestos in the various, suspect source materials and to characterize the types and levels of asbestos, when present. Data describing local meteorology were also collected;

- third, emission and dispersion modeling was conducted to derive estimates of the concentrations of each pollutant of concern that may develop at the location of the proposed sports complex, given the location and emission rate for each source, the characteristics of the pollutants emitted, and the range of meteorological conditions common to Waukegan; and

- fourth, effects potentially attributable to pollutant concentrations at the location of the proposed sports complex were evaluated by comparing concentration estimates to governmental standards for such airborne pollutants (to the extent that they exist) or to other relevant health-related criteria or prevailing concentrations within Waukegan (when standards do not exist).

Due to differences in the general manner in which such pollutants are typically categorized and evaluated, the set of pollutants of concern identified for consideration in this report were divided into "criteria" pollutants and "non-criteria" pollutants, which were separately evaluated. Criteria pollutants include the relatively few air contaminants for which the U.S. Environmental Protection Agency (USEPA) has adopted standards termed "National Ambient Air Quality Standards" (NAAQS). Non-criteria pollutants potentially include a broad range of other potentially hazardous contaminants that are typically reported on the Toxic Release Inventory[1] (TRI) or otherwise reported and entered into the state emissions inventory of the Illinois Environmental Protection Agency (IEPA). Because of their special relationships to the site, asbestos and lead were also evaluated separately from other contaminants.

The remainder of the report is organized as follows:

- Chapter 3 (background) provides a description and history of the site and a brief discussion of the health standards and criteria employed in this document;
- Chapter 4 documents the evaluation of criteria and non-criteria pollutants;
- Chapter 5 documents the special evaluation of asbestos and lead;
- Chapter 6 presents general conclusions and recommendations; and
- Chapter 7 presents references.

---

1 The TRI is a USEPA managed database of chemicals released into the environment from facilities that are required to report under the Emergency Planning and Community Right to Know Act (EPCRA).

3. BACKGROUND

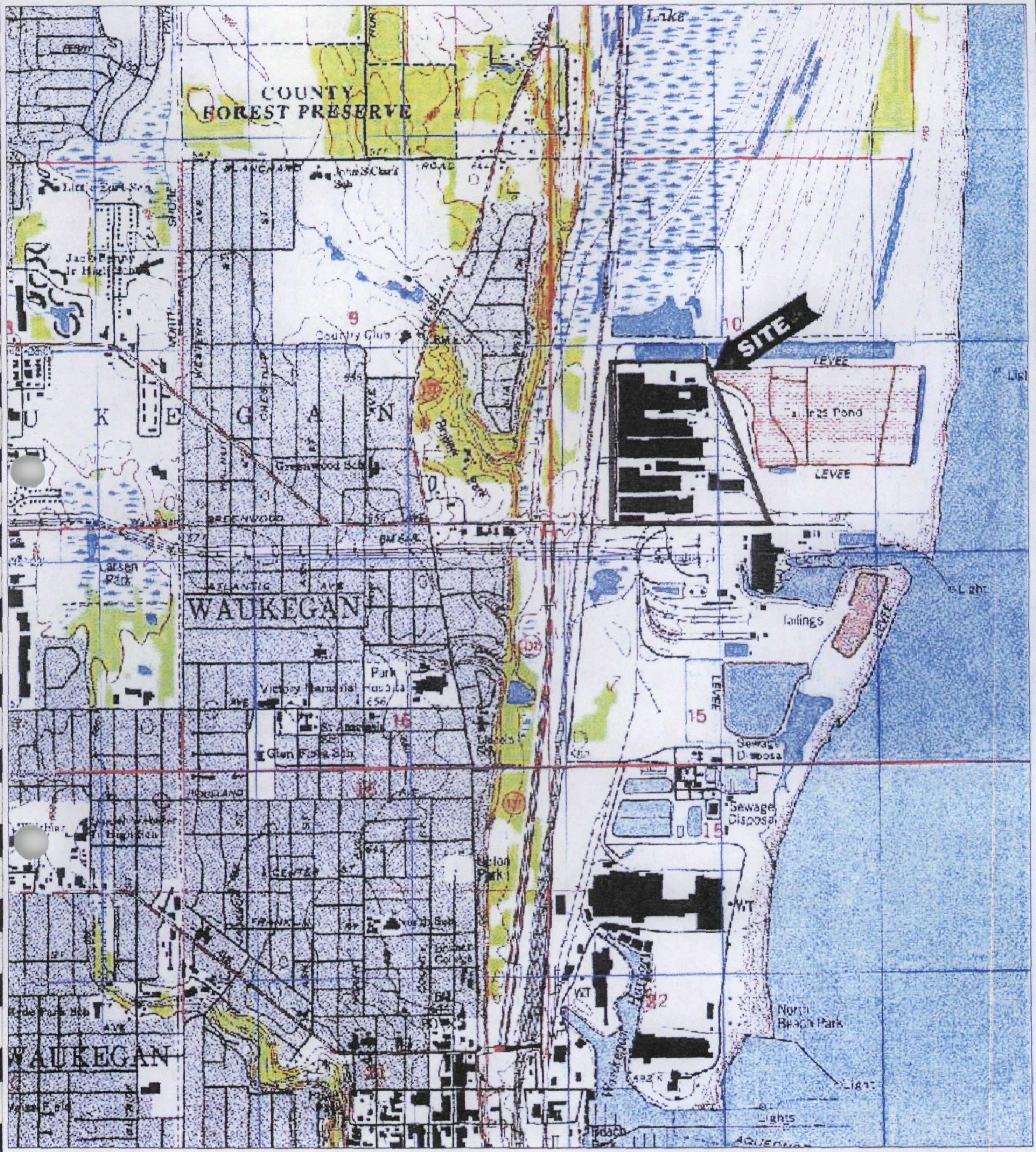
Brief descriptions of site features, site history, and relevant health standards and criteria are presented in this Chapter.

3.1 Site Description

The former JM manufacturing facility is an approximately 300 acre site located at 1871 Pershing Road, Waukegan, Illinois. The site is bounded to the north by the Illinois Beach State Park and Nature Preserve, to the east by Lake Michigan, to the south by Greenwood Ave and the Midwest Generation Station (which is a coal-fired electric generation plant that lies across Greenwood Ave), and to the west by the Union Pacific railroad tracks. A contour map, showing the location of the former JM facility is provided in Figure 3-1.

A detailed plot plan of the former JM facility is provided in Figure 3-2. As indicated in this figure, the former JM facility is divided into three main parts: (1) an approximately 60-acre borrow area on the north, which is separated from the main part of the site by a pumping lagoon; (2) an approximately 120-acre landfill and settling basin on the eastern part of the property (which is now the JM Disposal Area NPL site); and (3) the approximately 100 acre area on the western part of the property (south of the borrow area and pumping lagoon) on which the buildings of the former manufacturing facility were once located. As previously indicated, it is this third area on which it is proposed that the sports complex be developed.

A conceptual rendering of the proposed sports complex at the former JM facility is shown in Figure 3-3. As indicated in this figure, the proposed sports complex shares the same western boundary and southern boundary as the former JM facility. However, it occupies only the western portion of the JM property. Therefore, the pumping lagoon

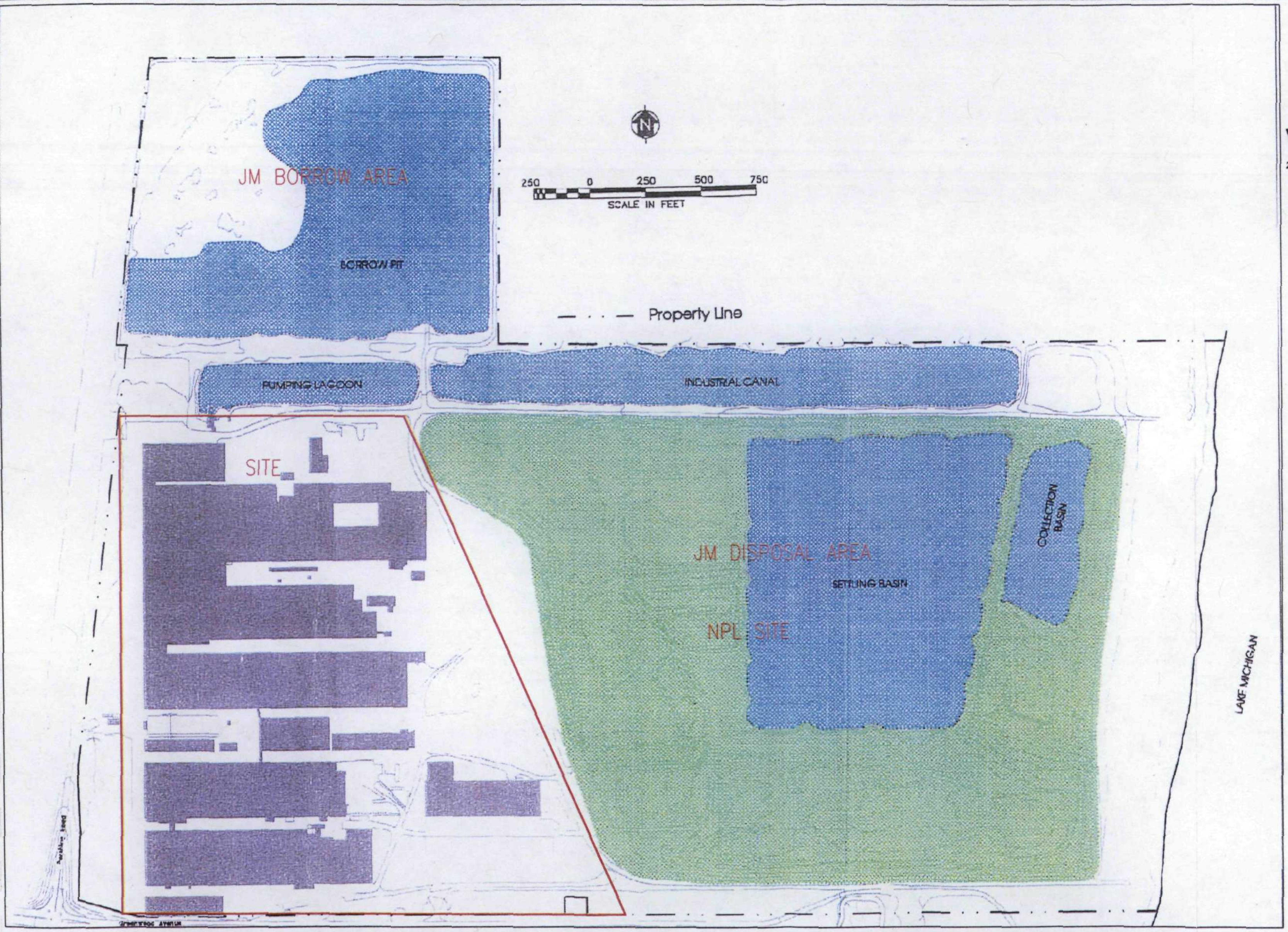


REFERENCE MAP:
WAUKEGAN AND ZION QUADRANGLES
ILLINOIS-LAKE COUNTY
7.5 MINUTE SERIES (TOPOGRAPHIC)
1963, PHOTOREVISED 1984

N

TITLE: FIGURE 3-1 SITE LOCATION MAP PROPOSED COMMUNITY SPORTS COMPLEX, WAUKEGAN, IL	
CAD: HDP	DATE: 10/16/01
APPROVED: CPW	SCALE: 1:24,000
FOR: WAUKEGAN PARK DISTRICT	
PROJECT NO. 105102.5102.009	
DRAWING NO. TOPO	

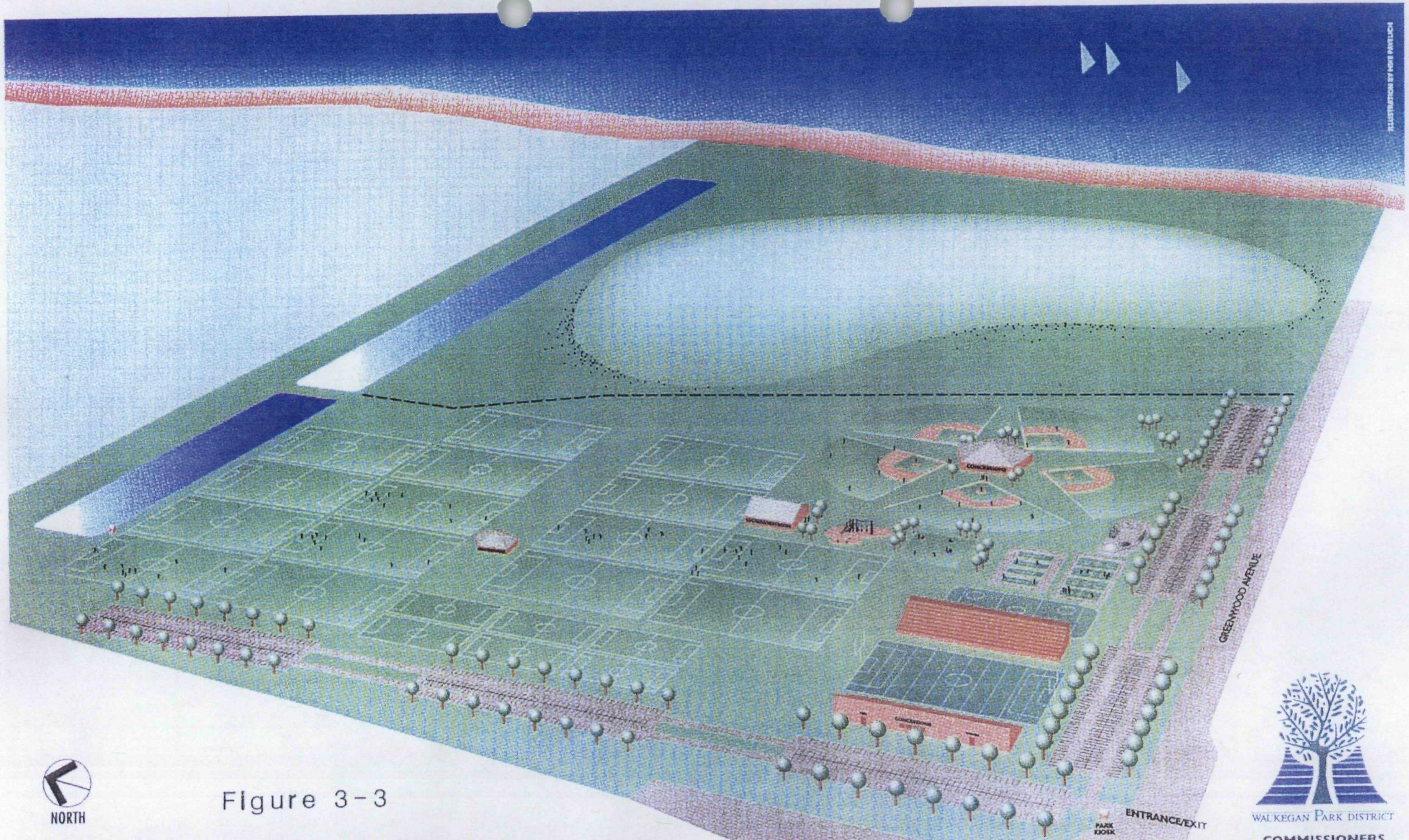
Versar INC.
200 W. 22nd STREET, SUITE 250
LOMBARD, IL 60148



Versar INC.
200 W. 22nd STREET, SUITE 250
LOMBARD, IL 60148

BASEMAP PROVIDED BY LEVINE-FRICKE

Figure 3-2
JM SITE
PLOT PLAN



NORTH

Figure 3-3

CONCEPTUAL RENDERING FOR WAUKEGAN PARK DISTRICT COMMUNITY SPORTS COMPLEX

MARCH 24, 2000 SUBJECT TO CHANGE

WAUKEGAN PARK DISTRICT

COMMISSIONERS
BILL BIANG
BILL DURKIN
JOE FAVERO
JANET E. KILKELLY
WAYNE MOTLEY

EXECUTIVE DIRECTOR
GREG PETRY

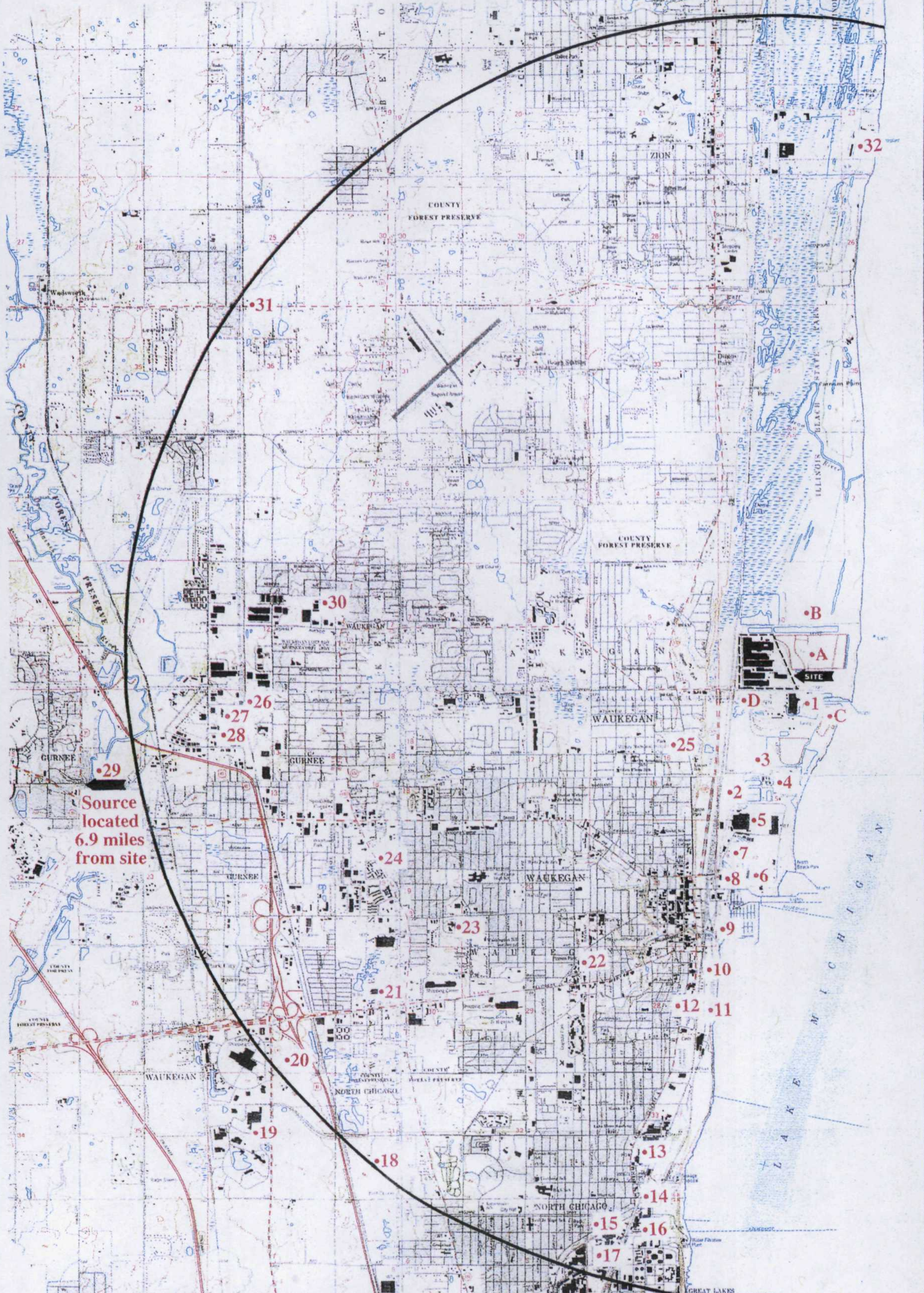
and the borrow area of the JM property lies to the north of the proposed sports complex site and the JM Disposal Area NPL Site lies east of the proposed sports complex site (between the site and Lake Michigan). Neither of these latter two portions of the JM property are included in the portion being considered for purchase by WPD.

Potential sources of criteria and non-criteria air pollutants that may be released and dispersed by wind so that they might affect the proposed sports complex were identified from maps and other information concerning local land use. A map depicting the location of such sources is provided in Figure 3-4. Both existing facilities and facilities proposed for future construction (where available information indicates) were considered. The set of sources addressed in this study are listed in Table 3-1, which also indicates the distance and direction to the facility from the proposed sports complex and the nature of the pollutants emitted. Detailed information indicating the complete set of pollutants associated with each of the specific sources considered in this study (along with the nature of specific emissions) is provided in Appendix A.

Soils and other exposed matrices potentially containing asbestos that were identified for consideration in this study include:

- **the JM Disposal Area NPL Site located immediately to the east of the proposed sports complex.** The landfill contains asbestos-containing debris. Berms, dikes, and unpaved roads on this property are reportedly built over base composed of asbestos-containing debris. Asbestos-containing debris has also been observed on the NPL site beach;

- **the sediments in the industrial canal to the north of the NPL Site**. Because process water from the JM site was cycled through the industrial canal, it is possible that asbestos-containing debris accumulated in industrial sediments;



TITLE: FIGURE 3–4
LOCATION OF SOURCES INVESTIGATED WITHIN FIVE MILES OF PROPOSED PARK SITE, WAUKEGAN, IL

CAD: HDP	DATE: 10/16/01	FOR: WAUKEGAN PARK DISTRICT
APPROVED: CPW	SCALE: 1" = 4000'	
Versar INC. 200 W. 22nd STREET, SUITE 250 LOMBARD, IL 60148		PROJECT NO. 105102.5102.009
		DRAWING NO. REGIONAL

N

REFERENCE MAPS:

USGS 7.5 MINUTE TOPOGRAPHIC SERIES: LIBERTYVILLE, WADSWORTH, WAUKEGAN, AND ZION QUADRANGLE MAPS; LAKE COUNTY, ILLINOIS

Table 3-1
Sources of Air Pollutants in the Vicinity of the Proposed Sports Complex

Source Location (Fig. 3-4)	Facility	Distance mi	Direction	Pollutants of Concern						
				Asbestos	Criteria					Non-Criteria
					SO2	Pb	PM	NOx	CO	
A	NPL SITE	0.238	E	X						
B	NATURE PRESERVE	0.511	N	X						
C	MIDWEST GENERATION - SAND PILE	0.584	SE	X						
D	MIDWEST GENERATION - WESTERN YARD	0.439	S	X						
13	ABBOTT LABS-N. CHICAGO PLANT	4.026	S		X		X	X	X	X
31	ACE	4.944	NW				X			
19	ALLEGIANCE HEALTHCARE	5.606	SW		X		X	X	X	
30	AVERY-DENNISON COMMERCIAL PRODUCTS DIV.	3.703	WNW					X		X
27	BASF/PPG INDUSTRIES	4.330	W		X		X	X	X	X
3	CHERRY ELECTRICAL PRODUCTS CORP.	0.903	S					X	X	X
32	COM ED - ZION	4.254	N		X		X	X	X	
24	CORAL CHEMICAL CO.	3.778	SW							X
20	COSMED OF ILLINOIS	4.988	SW							X
9	DEXTER CORP./AKZO NOBEL	2.204	S				X			X
29	DOMINO AMJET INC.	6.923	W							X
15	EMCO CHEMICAL DISTRIBUTORS, INC.	4.591	SSW		X		X	X	X	X
17	FANSTEEL, INC./FEDERAL DIE CASTING CO.	4.773	SW					X	X	X
28	GALLAGHER CORP.	4.445	W							X
18	GILLETTE CO. - N. CHICAGO PLANT	5.114	SW				X	X	X	X
7	LAFARGE CORP.	1.529	S				X			
11	LAKE SHORE FOUNDRY	2.480	S				X	X	X	
2	LAKESIDE/KINDER MORGAN - PROPOSED	1.079	S		X		X	X	X	
21	MEYER MATERIAL CO.	3.988	SW				X	X	X	
1	MIDWEST GENERATION - WAUKEGAN STATION	0.476	SSE		X	X	X	X	X	X
8	NATIONAL GYPSUM CO.	1.813	S		X		X	X	X	
10	NORTH SHORE PRINTERS	2.472	S					X		
4	NORTH SHORE SANITARY DISTRICT - PROPOSED	0.908	S		X		X	X	X	
12	NOSCO, INC.	2.764	SSW					X		
6	OUTBOARD MARINE CORP./BOMBARDIER RECREATION-PLANT 1	1.713	S		X		X	X	X	X
5	OUTBOARD MARINE CORP./BOMBARDIER RECREATION-PLANT 2	1.285	S		X		X	X	X	X
22	PFANSTHIEL LABORATORIES	2.813	SW				X	X	X	X
16	R. LAVIN & SONS, INC.	4.498	SW		X		X	X	X	X
26	ROQUETTE AMERICA, INC.	4.116	W				X	X	X	X
23	ST. THERESE MEDICAL CENTER/PROVENA	3.211	SW		X		X	X	X	X
14	STONE CONTAINER CORP.-N. CHICAGO PLANT	4.304	S				X	X	X	X
25	VICTORY MEMORIAL HOSPITAL	1.168	SW					X	X	X

NOTE: See Appendix A for additional source information

- **the pumping lagoon and borrow area on the JM property, which are located north of the proposed sports complex.** Unpaved roads on this property are reportedly built over a base composed of asbestos-containing debris and other unpaved surfaces and the sediments in the pumping lagoon may also contain such debris;

- **the Illinois Beach State Park and Nature Preserve to the north of the property.** The preserve was included for consideration due to past observation of asbestos-containing debris on preserve beaches and the presence of an abandoned road believed constructed over a base of asbestos-containing debris;

- **the Midwest Generation facility immediately to the south of the former JM manufacturing site.** A sand pile (from dredging) on the site and various other unpaved areas of the site were suspected to contain asbestos;

- **the swale running north-south to the west of the proposed sports complex.** The swale was suspected to contain asbestos because it drains areas suspected to contain asbestos; and

- **the unpaved shoulders of Greenwood Ave. that runs along the southern boundary of the JM property.** These may contain asbestos due to proximity to areas on the former JM manufacturing facility property known to contain asbestos. It should also be noted that other unpaved areas along Greenwood Ave. have already been shown to contain asbestos that needs to be addressed.

3.2 Site History

The following site history is derived from (1) information provided by Johns-Manville staff (JM, No date) and (2) the Final Remedial Investigation Report for the JM Disposal Area NPL site (Kumar Malhotra & Associates 1985).

The Manufacturing Facility

The former JM asbestos manufacturing facility in Waukegan was started in approximately 1918 as a consolidation in which three other JM manufacturing facilities (the Milwaukee, Wisconsin City facility; the West Plants facility also in Milwaukee; and the Asbestos Shingle Company in Riverdale, Illinois) were relocated to the Waukegan site. Thus, manufacturing facilities for low temperature pipe coverings, packings, and insulation cements (from the City facility); for roofing materials, asbestos and rag felt paper, and magnesia products (from the West Plants facility); and for asbestos shingles (from the Riverdale plant) were all consolidated at the Waukegan site.

The Waukegan site was originally a 225-acre site consisting primarily of sandy swamp land. A portion of the land was then filled to support construction of buildings. This was accomplished by pumping sand from the northern portion of the property on which a canal was dredged so that water could flow from Lake Michigan to the western edge of the property. Water required for production was then pumped from this "Industrial Canal". An approximately 80-acre parcel, the borrow area, was added to the JM property in 1968.

Construction of the buildings at the Waukegan site was begun in 1919 and completed in 1923. The Power House, Paper Mill, and Roofing Plant were put in operation in 1922 and the entire plant was in operation by 1923. In 1928 a tar saturator was installed and in 1929 the Asphalt Floor Tile Department went on line. The production of Sanacaustic Tile also began in 1929. In 1929, construction also began on the Transite Pipe Building and the Asbestos Shingle building was expanded. In 1936, a Rock Wool building was also added. In 1941, a parking lot was leveled off and fenced on the western edge of the site.

Two major fires at the site were also reported. One fire was reported in the 1960's (with no reported injuries) and one in the 1970's (with two injuries reported).

On August 26, 1982, the JM Corporation filed for Chapter 11 and in 1985 production of all asbestos-containing products officially ended. Production of some non-asbestos containing products continued until about 1997.

The manufacturing (western) portion of the JM property is currently undergoing demolition, remediation, and closure. Following closure and preparation, it is proposed that the site be developed as a sports complex with various soccer fields, baseball/softball fields, and other park facilities for use by Waukegan residents.

Waste Handling

Beginning in 1922, the eastern portion of the site was used as a disposal area for solid and sludge waste consisting primarily of cuttings and waste products from the manufacturing of asbestos-cement pipe and residues of asbestos-containing roofing and insulation materials. Small quantities of other materials handled at the plant (including lead, chromic oxide, thiram, and xylene) may also have been included in the wastes deposited in this portion of the site. However, with the exception of asbestos and lead (which is known to have been used in the form of a fine powder in at least one manufacturing process, JM staff - private communication), the volumes of these other materials deposited on the NPL site are expected to have been inconsequential in terms of their ability to contribute to offsite effects via transport in the air. Thus, because transport in air is the exposure pathway by which offsite contaminants might affect future users of the sports complex; of the contaminants potentially associated with JM operations, only asbestos and lead are further addressed (see Section 5.1).

A closed-loop water treatment system was also constructed on the eastern portion of the JM property where waste water from the plant was pumped to several settling lagoons and then to the Industrial Canal from where it would be returned to the plant.

In 1982, the eastern portion of the site that was used for disposal and water treatment was added to the National Priorities List (NPL) of Superfund Sites. A consent order signed in 1984 for this site required that a remedial investigation and feasibility study be conducted and that the site be properly closed. To date, the disposal areas of this site have been closed and capped and the remaining settling basin of the water treatment system is also scheduled for closure.

3.3 Health Standards and Criteria

As previously indicated, because criteria pollutants, non-criteria pollutants, and asbestos have been addressed differently in the regulatory arena, different kinds of health standards and criteria are available for evaluating health risks potentially attributable to exposure for each category of pollutant. The standards and criteria employed to evaluate each of these contaminants are described below following a brief description of the concept of risk.

3.3.1 About Risk

Exposure to pollutants may cause two generally different kinds of adverse health effects: carcinogenic effects (cancer) and non-carcinogenic effects. Regulatory agencies traditionally evaluate the risk from these two kinds of effects in entirely different ways.

> Note that some pollutants are known to cause only non-carcinogenic effects, some only carcinogenic effects, and some both. Regulatory agencies have developed corresponding standards or other health-related criteria accordingly.

<u>Non-carcinogenic Effects</u>

Regulatory agencies typically model non-carcinogenic effects as "threshold" effects. This means that such effects occur only when exposure is sufficiently high to trigger biological changes that lead to such effects. Below some minimum level of exposure, these effects are not expected to occur at all. Therefore, below this minimum, exposures can be considered safe.

Some non-carcinogenic effects can occur as a consequence of short-term exposure at relatively high levels (termed acute effects), long-term (typically lifetime) exposure at relatively lower levels (termed chronic effects), or both. Both acute and chronic effects are considered for specific pollutants in this study, as appropriate.

For acute effects, risk is evaluated in this study by considering the ratio of estimated exposure concentrations divided by corresponding criteria that represent safe levels of exposure. Thus, acute effects are generally considered to be a problem if the ratio exceeds one (indicating that the estimated exposure exceeds the target level). To be conservative, regulatory agencies typically establish action levels (concentrations at which action may be triggered) for acute effects at ratios of 0.5. Thus, if these ratios are less than 0.5, exposures do not unacceptably contribute to acute risk.

Two sources of target "safe" concentrations for acute effects were employed in this study to cover the range of pollutants considered. The California Office of Environmental Health Hazard Assessment (COEHHA) publish "Acute Reference Exposure Levels" (RELs) and the Federal Agency for Toxic Substances and Disease Registry (ATSDR) publish "Minimal Risk Levels" (MRLs).

A similar approach is employed for chronic effects. In this case, for specific chemicals, the estimated chronic exposure concentration is divided either by a Reference Concentration (RfC) or converted to an intake and divided by a Reference Dose (RfD) to generate a hazard quotient (HQ). As for acute effects, as long as the hazard quotient is less than 0.5 (established by regulatory agencies to be conservative), it is generally considered that the corresponding exposure will not unacceptably contribute to risk.

Importantly, when deriving HQ's, the appropriate chronic toxicity criterion must be chosen for use. Not only must the criterion be chosen to match the chemical of interest, but each criterion must be matched for exposure pathway (inhalation for this study) and for the form of the environmental concentration being compared. Because in this study, we are comparing estimates of concentrations that humans may inhale (as opposed, for example, to *oral* concentrations or inhalational *intake* estimates), the appropriate criterion for each chemical of interest is the inhalation RfC. In some cases, when the appropriate inhalation RfC is unavailable, but a regulatory agency has derived a chronic toxicity criterion for other pathways or environmental media (such as an oral RfD or an inhalation RfD), the appropriate RfC can be derived based on relatively simple and standard conversion formulas that are approved by the regulatory agencies.

Because chronic exposures are long-term (unlike acute exposures), so that there is reasonable probability that exposures to multiple pollutants will overlap, chronic effects from combined exposures to multiple pollutants are also evaluated by computing a hazard index (HI), which is simply the sum of the calculated hazard quotients over all pollutants:

$$HI = \Sigma_i HQ_i$$

As long as the HI is less than 0.5 (again established by regulatory agencies to be conservative), the combined, chronic exposure to multiple pollutants is not expected to contribute to risk.

<u>Carcinogenic Effects</u>

Regulatory agencies typically model carcinogenic effects as "non-threshold" effects. This means that, as long as exposure is not zero, there is at least some probability that such an exposure might lead to cancer. However, low-level exposures are typically associated with very low probabilities of causing cancer, which are so small as to be inconsequential.

For example, the background mortality rate for cancer in the United States is approximately 20% (CDC 1999), meaning that approximately one in five Americans die of cancer. In comparison, the regulatory agencies have established a risk range of 10^{-6} (one-in-a-million) to 10^{-4} (one-in-ten thousand) as the range over which management of cancer risks is determined.

More specifically, if the risk due to exposure to a particular carcinogen is less than 10^{-6} or one-in-a-million (meaning that only one excess cancer would be expected to occur among a population of a 1,000,000 people exposed at the estimated level), regulatory agencies consider this risk to be so small as to be acceptable under all circumstances. If the risk due to exposure is greater than 10^{-4} or one-in-ten thousand (meaning that only one excess cancer would be expected to occur among a population of 10,000 people exposed at the estimated level) regulatory agencies typically consider that such a risk is unacceptable and would require action. In between these two extremes, regulatory agencies generally make decisions on a case-by-case basis.

Given that even a one-in-ten thousand risk is minuscule in comparison to the background cancer mortality rate of one-in-five (which is 2,000 times larger), this method for regulating exposure to carcinogens is extremely health protective. In this study, we have adopted a target acceptable risk level of 10^{-5} or one-in-one hundred thousand (which is 20,000 times smaller than the background rate).

3.3.2 Criteria Pollutants

As previously indicated, criteria pollutants are regulated against their corresponding National Ambient Air Quality Standard (NAAQS). USEPA has developed NAAQS for Carbon Monoxide (CO), Particulate Matter less than 10 μm in diameter (PM_{10}), nitrogen dioxide (NO_2), Sulfur Dioxide (SO_2), Ozone (O_3), and Lead (Pb) as criteria pollutants. Note that, due to its use onsite, lead was also evaluated as part of the field investigation for asbestos (see Section 5.5).

Of these, Ozone is typically generated as a consequence of atmospheric photochemical reactions involving a range of volatile organic compounds (VOC's) that are emitted from multiple sources and that are regulated to control Ozone formation. For this reason, Ozone is typically evaluated on a regional (rather than local) scale so that it will not be addressed further in this document. However, various VOC's are also individually identified as non-criteria pollutants and are addressed as such in this study (see Section 3.3.3).

As previously indicated, the standards employed for evaluating health effects from criteria pollutants are the NAAQS. The existing standards are based on scientific reviews conducted by the USEPA and are reevaluated every few years to determine whether current data indicate that a change in a standard should be instituted.

The averaging time over which the various NAAQS apply differ for different pollutants. The averaging time is the duration over which the concentration of a particular pollutant needs to be averaged to determine whether the corresponding standard has been exceeded. For example, both a one-hour and an eight-hour standard exists for carbon monoxide. Standards for respirable particulate matter (i.e. particulate matter sufficiently small to be inhaled and deposited in the deep lung[2]) have been set for both annual averages and for 24-hour averages. Sulfur dioxide standards exist for three hours, for 24 hours, and for one year averages. The lead standard is for averaging over one-quarter of a year, which in this study was evaluated as a 24-hour maximum to be conservative. Because users of the proposed sports complex will typically remain at the complex only for relatively short periods of time (hours), the shorter term NAAQS

---

[2] To be respirable, particulate matter must generally be smaller than approximately 10 µm (micrometers) in diameter. Hence the notation: PM_{10}.

were adopted in this study as the appropriate standards for evaluating criteria pollutants.

To date, the USEPA has only established an annual standard for NO_2 (not a short-term standard). Therefore, because the goal in this study is to evaluate effects from shorter-term exposures (see above), a one-hour standard for NO_2 that was developed by the California Office of Environmental Health and Hazard Assessment (COEHHA) was adopted for use in this study (See Section 4.1).

3.3.3 Non-criteria Pollutants

Because federal standards have not been developed for non-criteria pollutants, these pollutants were evaluated based on other health criteria (e.g. published inhalation RfCs for chronic, non-carcinogenic effects; slope factors for cancer; and MRLs for acute effects), which are available from numerous Federal sources (see Section 4.2.4). In some cases, although the requisite criterion may not have been available for a particular toxic end point and a particular chemical, toxicity criteria for the same toxic end point may have been available for the particular chemical but for a different exposure pathway. In such cases, the requisite criteria were derived using standard conversion factors. Thus, for example, if an inhalation RfC for a particular chemical were not available, toxicity criteria for other exposure pathways (e.g. oral or inhalation RfDs) for the same chemical could be converted to derive the requisite RfC.

Because criteria for these chemicals had to be obtained from multiple databases, a scheme was adopted for prioritizing such databases that favors criteria derived from the most widely used and accepted databases (e.g. Federal databases) over criteria from less widely used and accepted databases (e.g. state databases). Details describing the prioritization scheme and the sets of criteria used in this evaluation are provided in Section 4.2.4.

3.3.4 Asbestos

Inhalation of asbestos dusts has been linked to several adverse health effects including primarily asbestosis, lung cancer, and mesothelioma (Berman and Crump 1999a and b). Asbestosis, a chronic, degenerative lung disease, has been documented among asbestos workers from a wide variety of industries. However, the disease is generally expected to be associated only with the higher levels of exposure commonly found in workplace settings and is not expected to contribute substantially to potential risks associated with environmental asbestos exposure. Therefore, asbestosis is not addressed further in this document.

The lung cancer associated with asbestos exposure is the same type of lung cancer commonly associated with smoking and the effects of concurrent exposure have been shown to be synergistic (Berman and Crump 1999b). Mesothelioma is a rare cancer of the membranes that surround the pleural cavity (i.e. the heart and lungs) and the peritoneal cavity (i.e. the gut). This cancer is considered an indicator for asbestos exposure as it has been found almost exclusively in association with exposure to durable fibrous materials.

Gastrointestinal cancers and cancers of other organs (e.g. larynx, kidney, and ovaries) have also been linked with asbestos exposures (by inhalation) in some studies. However, such associations are not as compelling as those for the primary health effects (i.e. lung cancer and mesothelioma) and the potential risks from asbestos exposures associated with these other cancers are much lower (U.S. EPA 1986). Consequently, this document is focused on risks associated with the induction of lung cancer and mesothelioma.

The procedures employed in this study to evaluate health-related risks associated with asbestos are those recommended in the protocol by Berman and Crump (1999a). Consequently, asbestos is measured in a manner consistent with the exposure index recommended in the protocol and risk is estimated using the recommended dose-response coefficients and models for lung cancer and mesothelioma, respectively. To facilitate analysis in this study, the models were used to generate tables of acceptable exposure concentrations that could then be compared directly with estimated exposures derived from the field investigation (see Chapter 5).

4. AIR POLLUTANT ANALYSIS

Criteria pollutants are evaluated in Section 4.1 and non-criteria pollutants are addressed in Section 4.2.

4.1 Criteria Pollutant Analysis

The criteria pollutant investigation consisted of several levels of analysis in which the number of sources, models, area investigated, and the meteorology employed were continually increased in resolution. Health risk evaluations are typically performed in stages, initially starting with conservative (i.e. protective), screening level data inputs and assumptions. The rationale for first conducting a screening level investigation being that, if health standards or criteria are achieved in the first level of analysis, the further refinement of input data and models isn't required. This approach is less time consuming and more cost-effective.

Several levels of modeling were employed to evaluate the potential for adverse air quality impacts from criteria pollutants at the proposed sports complex, with each level becoming progressively more detailed in source, meteorology, and receptor descriptions. The Level I analysis consisted of evaluating the criteria pollutant concentrations that could be experienced only from sources located at Midwest Generation's Waukegan Generating Station (WGS). The WGS was selected for the initial focus of the investigation due to it's size and proximity (directly southeast of the site). We selected the current version of USEPA's SCREEN3 model (USEPA, 1995) to perform air quality dispersion modeling in a screening mode for these sources. The SCREEN3 model was used to obtain concentration estimates at specified distances for each emission source at the WGS.

When the results of the Level I analysis showed the potential that criteria pollutants could adversely impact the proposed sports complex, the analysis was expanded to

Level II to include all sources located within five miles to the south of the site. The southern direction was selected because many of the other sources in the area are located to the south along the lakefront and winds from the south could cause the plumes from many of them to become commingled, which would potentially lead to increased concentrations at the site. The five mile radius was selected as an appropriate distance that would include those sources with substantial potential to contribute adversely to air quality at the site. A few sources beyond five miles were also evaluated during modeling to verify that they would have no substantial influence on the results. Due to limitations of the SCREEN3 model, the ISCST3 dispersion model was selected for use in the Level II analysis and all successive modeling efforts. The ISCST3 model is a complex model (on which the SCREEN3 program is based) that allows for simultaneous consideration of multiple sources, receptors, and additional meteorological conditions.

The Level II investigation showed elevated concentrations for two criteria pollutants (PM_{10} and NO_2) when compared with threshold levels selected for evaluation. As a result, a Level III analysis consisting of highly detailed, refined dispersion modeling was conducted. Level III employed five years of meteorological data from the Chicago area and incorporated consideration of all the criteria pollutant emission sources identified within a five mile radius of the proposed sports complex.

4.1.1 Dispersion models

We selected the current version of USEPA's SCREEN3 (USEPA, 1995) to perform air quality dispersion modeling in a screening mode. The SCREEN3 model is a computer program utilized to perform preliminary assessments of air pollutant impacts from an individual point, area, or volume emission source. SCREEN3 evaluates a single source using a predefined set of fifty-four meteorological conditions of wind speed and atmospheric stability to identify the potential worst-case air pollution concentrations. The model calculates downwind concentrations for a selected range of downwind distances and then interpolates to determine where the maximum concentration will occur. SCREEN3 also performs calculations to determine if a stack plume can be affected by an adjacent building. This is important for sources located close to the site of interest because buildings can influence the stack effluent concentrations in two ways: either by creating a downwash wake effect in which the plume is drawn closer to the ground or by trapping the stack exhaust within the building cavity zone (a pocket of air near the downwind side of the building) thus generating high concentrations in the immediate vicinity of the building. The model was used to determine the maximum concentration locations and potential cavity concentrations for emissions sources located at the WGS.

Preliminary results indicated more detailed modeling was warranted because the screening level analysis suggested the possibility such standards could be exceeded for PM_{10} and NO_2. Therefore, the ISCST3 model was selected for more refined modeling. The ISCST3 model is a regulatory, Gaussian based multi-source, short-term dispersion model approved by the USEPA in their Guideline on Air Quality Models (Appendix W, 40 CFR Part 51). The model is capable of estimating concentrations from one-hour to annual periods for releases from multiple point, area, line, and volume sources for either flat or intermediate rolling terrain. The most recent version of the ISCST3 model obtained from the USEPA Technology Transfer Network (TTN) SCRAM web site was utilized to generate concentrations for each of the pollutants.

The ISCST3 model used for the Level III analysis is the same as that used for the Level II evaluation with two major exceptions. First, all the major sources from the Illinois Environmental Protection Agency (IEPA) emission inventory for a given pollutant were included in the modeling (for the Level III evaluation) rather than just those located to the south of the proposed sports complex. Second, the screening meteorology was replaced with five years of actual meteorological data from O-Hare International Airport. Except for these two major refinements, the model options employed for Levels II and III analysis predominantly remained the same.

4.1.2 Source data

IDENTIFICATION

The first step in our analysis was to identify the air pollutant emission sources and to acquire the information necessary to perform the analysis. Several approaches were taken to compile the list of sources. We reviewed the USEPA's Toxic Release Inventory (TRI) for 1998 and 1999 using a county and zip code search and compiled a preliminary list of sources in the Waukegan area. We then contacted the IEPA to request both criteria and non-criteria pollutant emission inventories for the industrial plant sources identified within five miles of the site. In addition, an inspection of the IEPA database for air permit applications was performed, during which we identified two additional sources in the area that are proposed for construction. These are a gas turbine power plant (Kinder-Morgan - previously referred to as Lakeside) and a proposed project at the North Shore Sanitary District (NSSD). These two additional sources were included in the modeling analysis.

A total of 28 facilities were identified for inclusion in our modeling analysis to evaluate potential impacts from the criteria pollutants. However, the number of facilities contributing to air concentrations varied for specific pollutants. The facilities included in our analysis are listed in Table 3-1. Within each of the 28 facilities are varying numbers of sources depending on the pollutants emitted. After preliminary review, it was determined that the sources contributing most substantially to the proposed site were those located to the south. The WGS sources located directly southeast of the proposed sports complex were examined most closely and were included in all the modeling performed. Several sources of data were reviewed to obtain the best characterization of the sources for this facility. Building dimensions were also identified and reviewed for the WGS sources.

ACQUISITION

Much of the data we used for characterizing criteria pollutant sources came from the IEPA compiled emission inventory for sources in the study area. We also contacted

Midwest Generation EME, LLC, Abbott Laboratories, and Outboard Marine Corporation/Bombardier (OMC) directly to obtain copies of their Title V permit applications, current Annual Emission Reports, and any other supplemental data they could provide. Title V of the Clean Air Act is the section that requires major emission sources to submit comprehensive operating permits. In Illinois, the Title V program is administered by the IEPA.

The developer of the proposed Lakeside (Kinder Morgan) gas turbine power plant was also contacted to obtain information regarding the proposed operation. Modeling data prepared for the application was provided and incorporated into the modeling analysis. Since that time, the project has been assumed by Kinder Morgen but has remained labeled as Lakeside in our database. We would like to acknowledge Kinder Morgan for their cooperation in providing input data required to refine our analysis.

Likewise, the NSSD was contacted to obtain emissions data and other modeling parameters for the proposed sludge melter project to be constructed at the Waukegan sewage treatment plant. Sources from this proposed facility were included in the refined modeling. We would like to acknowledge NSSD for their cooperation in providing input data required to refine our analysis.

During the analysis, we learned that OMC filed for bankruptcy and Bombardier assumed responsibility for a portion of their Waukegan facility. Bombardier allowed us access to a copy of the Title V permit application for the facility to obtain better source data. We conferred with Bombardier personnel regarding the operating and non-operating sources present at the facility to better represent actual and potential operations at the facility. We have retained the OMC reference in our database for simplification in the modeling.

EVALUATION

The compiled source data were reviewed for completeness. Varying levels of detail were utilized in reviewing the data. A more detailed review was performed for those sources located closest to the proposed sports complex (e.g. WGS) and the level of detail decreased with distance from the site.

For the WGS, we compared the IEPA data to the Title V permit application data and found several discrepancies. Some IEPA sources consisted of default values assigned to source parameters, due to lack of information available to the IEPA. For example, estimated stack exit temperatures were provided when maximum exhaust temperatures were unavailable or area sources were provided as point sources. Since some of the source data contained these discrepancies, we selected the most recent Title V permit application data as the most accurate representation of operations at the WGS for use in the model. The maximum allowable emission rate associated with the "worst-case" firing mode was selected for each criteria pollutant. The maximum temperature and flow rate was also selected for each source.

Prior to the final refined modeling runs, we requested several major facilities to review the modeling data to assure its accuracy. Midwest Generation, Abbott Labs, and OMC/Bombardier were provided the opportunity to review the source parameters and emissions of PM_{10} and NO_2. This is because preliminary modeling runs indicated NO_2 and PM_{10} were of concern and these three sources were the major contributors in the area. Midwest Generation reevaluated their fugitive emissions and adjusted the PM_{10} values based on updated emission calculations. They also adjusted their potential NO_2 emissions from the boilers to reflect the current regulatory limits they are required to meet since the time the Title V application was prepared. Abbott Labs and OMC/Bombardier also reviewed the PM_{10} and NO_2 emissions provided to us by the IEPA. Abbott Labs provided updated source data information for their facility. OMC/Bombardier provided access to their Title V to allow correct representation of the recently reduced operations at the Waukegan facility. We would like to acknowledge

Midwest Generation, Abbott Labs, and OMC/Bombardier for their cooperation in providing input data required to refine our analysis.

During the final phase of refined modeling, we became aware of a large gas turbine electric generation project proposed for construction by Excelon Generation Company. The combined cycle plant would be located on the southeast corner of Dahringer and Pershing, in the same vicinity as the proposed Kinder-Morgan plant. Excelon elected not to provide data for their proposed project because it was still in the preliminary engineering stage but indicated they would provide data when available. Therefore, we did not include this proposed source in our analysis.

IMPLEMENTATION

In the Level I analysis, sources input to the SCREEN3 model utilized a generic emission rate of 1.0 gram/sec (g/s) for WGS sources to allow for easy scaling of emission rates. Receptor locations were generated for distances downwind of the release point to simplify modeling. Receptor locations are points where the model computes air concentrations of pollutants. No terrain elevations were selected since the area is relatively flat compared to the release height of the sources at the WGS. A total of fourteen emission sources were input to the model for the WGS. Five of the sources represent point sources from combustion units (i.e. three main boilers and heaters), seven represent point releases from particulate emission sources, and one represents the area source emissions from the coal storage pile and management of the pile (i.e. tractor leveling, etc.). Area source emissions were based on a 15-acre square area listed in the Title V permit and the location was translated from aerial photos to a topographic map to obtain coordinates. The Universal Transverse Mercator (UTM) is the metric-based coordinate system employed since it is found on USGS topographic maps. An average height of 15 feet was assumed based on visual inspection of the coal pile. Maximum concentrations were determined for each source and combined together to obtain a conservative overall concentration.

For the Level II analysis, the source data used for the WGS SCREEN3 analysis was also utilized in the ISCST3 screening model analysis. The only differences between the SCREEN3 and ISCST3 data consisted of the source emission rate and location. The ISCST3 model used the maximum allowable emission rates for each source and pollutant (CO, SO_2, PM_{10}, and NO_2). The ISCST3 model also uses location coordinates to maintain the proper source/receptor geometry configuration. UTM coordinate locations for each of the sources were obtained from the USGS 7.5 minute Zion, Waukegan, Libertyville, and Wadsworth topographic maps.

In addition to the large WGS sources evaluated in the Level I analysis, additional smaller sources were identified from the Title V permit application. The maximum permitted emission rates for these additional sources at the WGS were obtained from a copy of the Title V permit application provided by Midwest Generation EME, LLC. They were selected based on the maximum annual emission rates and converted to hourly rates based on the maximum hours of operation of the sources. Each of the stack parameters consisted of the plant stack ID, height, temperature, and diameter. Also obtained were the volumetric flows for each stack, which were converted to exit velocities using standard engineering calculations.

The other sources modeled in the Level II analysis consisted of those provided in the emission inventory from IEPA for criteria pollutant emission sources located within five miles of the proposed sports complex. These are shown in Figure 3-4. The data for these sources consisted of general source location, hourly and annual emission rates for a given pollutant, source heights, diameters, temperatures and velocities. Building dimensions were not provided by the IEPA. Since most of the facilities were located at a distance greater than building downwash influences are usually experienced, they were deemed not to be necessary for inclusion in the model.

In the Level III analysis, we incorporated all the sources listed in the IEPA emission inventory in the refined modeling exercise to ensure complete coverage when using all possible wind directions. The list of facilities included in the criteria pollutant analysis is shown in Table 3-1, though some facilities may not be included for some individual model runs, since they were not listed as emitting those pollutants (as shown in the table).

4.1.3 Meteorology

Level I modeling utilized screening meteorological conditions. Meteorological data for the maximum concentration impact distance and cavity analysis consisted of a default set of 54 hours of "worst case" meteorological conditions of wind speed and atmospheric stability utilized by USEPA's SCREEN3 model. The model assumes each meteorological condition results in impacts directly downwind of the source for a range of distances selected by the user. Mixing heights are determined by the model on a case-by-case basis depending on the stack height, wind speed, and stability based on the selection of either an urban or rural dispersion mode. The mixing height is a "lid" or limit to vertical mixing in the lower atmosphere caused by temperature differences.

The urban or rural dispersion mode setting affects the type of dispersion factors applied to the effluent plumes upon release from the stack. Selection of the proper dispersion mode is important due to the differences in how rural landforms such as water, trees, and grasslands affect dispersion in comparison to tall buildings in urban settings. The mode can be determined using several different approaches. We utilized the Auer (1978) method to identify the appropriate dispersion parameters for use in the model analysis. The Auer method evaluates the type of land use within a three-kilometer radius around the site. Since the area within a three-kilometer radius consists primarily of woods, dunes, water, parks, and other natural features as well as suburban dwellings, the rural setting was selected.

For Levels II and III, the ISCST3 model was utilized in the analysis. In Level II, meteorological data for the ISCST3 screening analysis consisted of the same 54 hours as used in the SCREEN3 model, but included a range of wind directions from south to southwest in five-degree increments to address the range of wind directions from several sources that may impact the sports complex. This resulted in a data set of just over 20 days of meteorological conditions. An annual average rural mixing height of 5,000 meters was used for neutral and unstable conditions while a mixing height of 10,000 meters was applied to stable conditions.

The Level III refined modeling meteorology consisted of five years of actual surface weather observations for O'Hare International Airport combined with upper air weather observations from Peoria for the years 1987 through 1991. Peoria is the closest location for upper air observations. The O'Hare Airport data is a standard set of five years utilized by the IEPA for modeling exercises in northeastern Illinois. The data were processed using standard USEPA procedures.

4.1.4 Receptors

Receptors are locations at which the dispersion model calculates expected air pollutant concentrations. For the Level I screening analysis, a range of receptor distances from 50 to 2500 meters was selected to cover the distance across the proposed sports complex in the SCREEN3 model. The range was designed to encompass the limits of the proposed sports complex in relation to the WGS release points. Since the area is relatively flat, no vertical adjustments were made to the receptor points.

As the modeling became more refined in the Level II and III analyses, more specific locations needed to be defined to properly identify the geographic relationship of the sources to the sports complex site. The receptors for the ISCST3 analysis consisted of eight locations within the boundary of the sports complex that are representative of activity areas in the park. They were defined in the model inputs by using UTM coordinates obtained from the U.S. Geological Survey topographic maps.

4.1.5 Level I analysis: SCREEN 3 dispersion modeling

The WGS sources were evaluated to determine weather additional modeling would be necessary. Two separate sources of air pollution concentrations that could result at the proposed sports complex were investigated in this analysis. First, air concentrations that could result from the entrapment of emissions within the cavity zone of the power plant were evaluated. High concentrations can occur in cavity zones when the stack exhaust becomes trapped within the building wake zone. Since the building wake zone can reach several hundred feet, it was important to evaluate whether this phenomena existed and posed a potential problem at the sports complex. Second, the distance to the maximum pollutant concentration that could be expected from a range of weather conditions was investigated. This was done to determine the possible range of influence the WGS sources had downwind toward the sports complex site. Both types of air concentrations from the WGS were investigated, due to its proximity to the site using the SCREEN3 model, which is capable of calculating the concentrations, distances, and the extent of the cavity zone dimensions.

The cavity analysis results indicated that cavity concentrations resulting from the main boiler building housing Boilers 6, 7 and 8 would not occur. This was due to the height of the stacks relative to the building height. Wind speeds in excess of 10 m/s would be required to capture some of the plume in the cavity region generated by the building. However, these higher wind speeds generate greater turbulence and would breakdown a cavity zone and mix the air contained in the cavity region with the surrounding ambient air. Thus, no cavity problems were predicted by the model for these sources and further analysis of cavity zone impacts were not considered.

The SCREEN3 modeling results of the maximum impact location were calculated for hourly predicted concentrations from each source. Hourly concentrations were used since the meteorology utilized by the model is based on hourly observations. The one-hour maximum concentration values were generated using a generic 1 gram per second (g/s) emission rate from each source and a 1.6 x 10^{-5} gram per second per square meter ($g/s/m^2$) emission rate from the coal pile area source (equivalent to a 1 g/s emission rate over the entire area). The modeling results indicated the distance to the maximum impact location from each of the three main boilers was determined to be about 1200 meters. Based on the stack location of each of the boiler units, this maximum would occur at or just beyond the far north end of the proposed sports complex.

The maximum impact location for the area source modeled was at a distance of 300 meters. Based on the location of the coal pile, this would occur within the WGS plant property. The other particulate sources would have maximum impacts occurring at distances of 68 to over 400 meters. Since these sources are located further inside the WGS plant property, the maximum impacts are expected to occur within the range from inside plant property to just inside the proposed sports complex. Due to the potential for impacts at the proposed sports complex from these sources, further modeling using more detail was warranted.

4.1.6 Level II analysis: ISCST3 screening dispersion modeling

Since the Level I screening results indicated the potential for pollutant impacts on the proposed sports complex from individual sources at the WGS, a more detailed screening analysis was required to evaluate impacts from these combined sources. To conservatively evaluate the worst case concentrations expected to occur, we included those facilities from the IEPA database previously described that were located south of the proposed sports complex within a distance of five miles.

The ISCST3 model was separately run for each pollutant over the range of worst case meteorological conditions described in Section 4.1.3 using the maximum allowable pollutant emission rate and stack parameters contained in the WGS Title V permit application. The emission rates and release parameters used for the other facilities located to the south of the proposed sports complex were obtained from the IEPA database. The model calculated the predicted concentrations at each given receptor for each meteorological condition and provided the highest predicted concentration in an output summary table from the model.

Maximum predicted one-hour concentrations for CO, SO_2, NO_2, and PM_{10} were generated and reviewed. The maximum one-hour concentrations were also converted to other averaging periods for comparison to the appropriate National Ambient Air Quality Standards (NAAQS) concentrations using USEPA accepted scaling factors (0.9 for 3 hour, 0.7 for 8 hour, 0.4 for 24 hour, and 0.1 for annual). The one hour concentrations are multiplied by these scaling factors, which are based on statistical analyses of historical meteorological data. The factors assume that the meteorological conditions creating the one-hour concentration would persist over the entire averaging period. This results in a conservative estimate consistent with the protective approach of the overall analysis.

To more adequately represent the actual concentrations that could be expected at the sports complex, background concentrations were added to the predicted concentrations. The background concentrations represent the existing ambient concentrations that would exist if the modeled facilities were not present. The background concentrations were obtained from the IEPA's 2000 Air Quality Report. The closest monitoring sites were selected from the annual report on a pollutant-by-pollutant basis. As a result, a representative value was selected for each pollutant from the northern Illinois sites available. These are noted at the bottom of Table 4-1.

Each of the maximum concentrations were combined with background concentrations for the appropriate averaging period and compared to the applicable pollutant standard. The CO and SO_2 concentrations predicted by the model were found to be below the NAAQS concentrations for the appropriate averaging periods. The PM_{10} predicted concentrations were found to exceed the 24-hour NAAQS, while the NO_2 one-hour

Table 4-1
Waukegan Park District
Summary of Highest Concentrations from Five Years of ISCST3 Model Runs
for Five Criteria Pollutants

Pollutant	Averaging Period	Highest	5 Year Highest Concentration µg/m³	Period mon/day/hr/yr	Background Concentration* µg/m³	Total Concentration µg/m³	NAAQS Concentration µg/m³	COEHHA Concentration µg/m³
CO	1 hr	1st High	3824.4	09/15/22/87	5485.7	9310.1	40,000	-
		2nd High	3585.1	11/09/22/91	5485.7	9070.8	40,000	-
	8 hr	1st High	1109.0	09/15/24/87	3000.0	4109.0	10,000	-
		2nd High	893.3	11/09/24/91	3000.0	3893.3	10,000	-
NOx	Annual	-	10.4	1990	29.7	40.12	100	-
	1 hr	1st High	612.3	06/12/10/90	112.3	724.6	-	470
		2nd High	457.2	02/12/19/90	112.3	569.5	-	470
PM10	Annual	-	4.36	1990	24.0	28.36	50	-
	24 hr	1st High	41.6	11/25/24/88	54.0	95.6	150	-
		2nd High	34.7	10/24/24/89	54.0	88.7	150	-
Lead	Quarterly	1st High 24-hr	0.023	08/09/24/90	0.020	0.043	1.5	-
SO2	Annual	-	5.27	1990	13.3	18.60	80	-
	3 hr	1st High	309.9	08/09/12/90	174.2	484.1	1300	-
		2nd High	256.9	07/02/12/90	174.2	431.1	1300	-
	24 hr	1st High	83.2	08/09/24/90	73.0	156.2	365	-
		2nd High	53.8	03/22/24/91	73.0	126.8	365	-

* Obtained from "2000 Illinois Annual Air Quality Report" published by the IEPA.

CO	Schiller Park for 1 hr and 8 hr highest samples
NO_2	Northbrook for annual arithmetic mean, Zion for 1 hr
PM10	Hoffmann Estates for 24 hr highest sample and annual arithmetic mean
Lead	Schiller Park for highest quarterly average
SO2	Chicago-CTA site for 3 hr and 24 hr highest samples and annual arithmetic mean

predicted concentrations were found to exceed the California standard. Thus, it was deemed that a more detailed, refined analysis was necessary to thoroughly evaluate the criteria pollutant concentrations that could be expected to occur at the proposed sports complex.

4.1.7 Level III analysis: ISCST3 refined dispersion modeling

As a result of the elevated PM_{10} and NO_2 predicted concentrations resulting from the ISCST3 screening modeling conducted in Level II, it was decided to evaluate the predicted concentrations of criteria pollutants from all large commercial sources located within five miles of the proposed site. The purpose of this Level III analysis was to ensure that all possible sources in the area were adequately evaluated for their potential contribution to criteria pollutant air concentrations at the proposed sports complex. The five mile radius was selected to ensure inclusion of all sources that might contribute substantially to airborne concentrations of criteria pollutants at the proposed sports complex in the modeling analysis. As described previously, five years of actual meteorological observations were used in the refined analysis.

A summary of maximum predicted concentrations from the refined dispersion model runs for each of the pollutants is shown in Table 4-1. The summary of the annual results from each of the five years can be found in Appendix B. Table 4-1 contains the following information:

- Column One identifies the pollutant;
- Column Two indicates the averaging period modeled for comparison to the applicable standard;
- Column Three indicates the highest and second highest concentration reported for the averaging period. The 1st highest is the overall highest for any receptor

within the averaging period reported in the model results. The 2nd highest is the next highest concentration to occur once all the highest concentrations at each receptor have been determined;

- Column Four includes the concentration value associated with the averaging period;

- Column Five indicates that time period when the predicted concentration from the previous column occurred;

- Column Six lists the background concentrations obtained from the IEPA annual report;

- Column Seven is the combined total of the concentration and the background concentration;

- Column Eight is the NAAQS concentration for comparison to the total concentration; and

- Column Nine is the concentration from the California standard for comparison with the NO_2 One-hour value.

As seen in the table, CO, PM_{10}, Lead, and SO_2 concentrations were all predicted below their respective air quality standards. Thus, no short-term concentrations in excess of the NAAQS for these pollutants should be expected to have an impact on sports complex users. Results are summarized for each criteria pollutant below.

Carbon Monoxide

Reviewing the table, we can see that the highest CO 1-hour concentration of 3824.4 micrograms per cubic meter (ug/m^3) occurred in the late evening hours of mid-

September. Adding the background concentration from the nearest Chicago area sampling site (Schiller Park) of 5486 ug/m^3 resulted in a total of 9310.1 ug/m^3. This is much less than the NAAQS of 40,000 ug/m^3. The same can be said of the highest 8-hour CO concentration of 1109.0 ug/m^3. When added to a background value of 3000 ug/m^3, the total is 4109.0 ug/m^3. This is less than half of the NAAQS value of 10,000 ug/m^3. Thus, CO concentrations at the proposed sports complex should not pose a health risk to users.

Nitrogen Dioxide

The highest annual NO_2 concentration was predicted to occur in 1990 with a value of 10.41 ug/m^3. When combined with the background concentration of 30 ug/m^3 from a monitor in Northbrook, the total concentration was calculated to be 40.12 ug/m^3. This is less than half the annual NAAQS of 100 ug/m^3 for NO_2. The highest one-hour concentration of 612.3 ug/m^3, when added to a background concentration of 112 .3 ug/m^3 from a monitor in Zion, resulted in an overall total of 724.6 ug/m^3. Thus, as in the Level II, the one-hour NO_2 concentration were still predicted to exceed the California one-hour standard.

The refined modeling indicated that the one hour California NO_2 standard would be exceeded only on relatively rare occasions. A total of 15 one hour exceedances were predicted in the five years of modeling data. In two of the years, 1989 and 1991, there were no predicted exceedances. One exceedance was predicted in 1987, six in 1988 and eight in 1990.

Technical documents supporting the California standard indicate that exceeding the one hour standard for NO_2 leads only to transient (i.e. reversible) health effects that include decreased airflow and increased bronchial sensitivity in asthmatics. Reversible, allergic and inflammatory responses were also observed in animal respiratory tracts. More severe effects in animals do not appear to occur except at exposure to higher levels for longer periods of time (weeks or longer).

The likelihood of exceedances occurring in the future and affecting park users is extremely remote for several reasons. The overwhelming contribution to these projected exceedances comes from three gas turbine jet engine peaking units located just west of the main Midwest Generation power plant. The modeling assumes that these jet peakers are operating at full capacity every hour of every day during the year. In reality, these peakers are used very infrequently and only during hot summer days, when the electrical demand is at its peak.

The likelihood of the peakers running at maximum capacity and the appropriate meteorological conditions occurring at the same time is extremely small. In addition, many of the predicted exceedances during the five year period occurred either during evening hours or off-peak months (when the generators are not used). A further conservative assumption is that a relatively high background level has been assumed to occur coincident with the contribution of the jet peakers and meteorological conditions which produce the maximum concentrations.

Given the above factors, therefore, it is very unlikely that predicted exceedances of the one hour California standard will actually occur. Therefore, any meaningful adverse impact on the health of individuals who visit the proposed sports complex due to NO_2 is unlikely.

Respirable Particulate Matter

The total annual PM_{10} concentration of 28.36 ug/m^3 is much less than the NAAQS of 50 ug/m^3. Much of this is due to the 24 ug/m^3 background added to the 4.36 ug/m^3 concentration predicted by the model. The highest 24-hour PM_{10} concentrations, which were exceeding the 24-hour NAAQS in the Level II screening modeling, show concentrations less than the PM_{10} NAAQS under the more detailed Level III modeling analysis. The 24-hour concentration of 41.6 ug/m^3, combined with a background of 54 ug/m^3, results in a total concentration of 95.6 ug/m^3. This is less than the NAAQS 24-hour concentration of 150 ug/m^3. The reason for the decrease in the 24-hour concentrations from Level II to III is largely due to the revisions to the PM_{10} source emission estimates made by Midwest Generation in their review prior to the final modeling. Given this analysis, we do not expect PM_{10} concentrations at the proposed sports complex to exceed the corresponding NAAQS so that PM_{10} will not contribute unacceptably to risk.

Lead

As a result of the lead-in-gasoline phaseout program, ambient lead concentrations throughout the Chicago Metropolitan area are well below the standard. A review of the emission inventory for the 5-mile study area revealed that the only important source of lead emissions was from coal combustion at the WGS power plant. Therefore, lead emissions were investigated from boilers at the WGS. Since the ISCST3 model is not capable of generating a three-month average (quarterly average) for comparison to the NAAQS, the highest 24-hour predicted concentration was utilized (a very conservative assumption).

The lead concentration generated for comparison to the NAAQS quarterly lead standard was based on the maximum 24- hour predicted concentration from the five years of meteorological data. The highest 24-hour lead concentration of 0.023 ug/m^3 was predicted to occur in August of 1990. This was combined with a background of 0.02 ug/m^3 obtained from the nearest Chicago area lead sampler site (Schiller Park). When added together, the total of 0.043 ug/m^3 is about one-quarter of the NAAQS of 1.5 ug/m^3 for lead. Therefore, based on this very conservative analysis, lead air concentrations at the proposed sports complex are not expected to pose a risk to users.

Sulfur Dioxide

The highest SO_2 concentrations for 3-hour, 24-hour and annual averaging periods all occurred with the 1990 meteorological data. The annual predicted concentration of 5.27 ug/m^3 combined with a background value of 13.33 ug/m^3 from the Chicago-CTA site, resulted in a total annual concentration of 18.6 ug/m^3. This is much less than the annual NAAQS for SO_2 of 80 ug/m^3. The highest 3-hour SO_2 concentration was 309.9 ug/m^3. When added to the background concentration of 174.2 ug/m^3, a total concentration of 484.1 ug/m^3 results, which is less than the 1300 ug/m^3 NAAQS for 3-hour SO_2 concentrations. The same applies for the 24-hour concentration of 83.2 ug/m^3. When added to the background concentration of 73 ug/m^3 a total of 156.2 ug/m^3 is provided. This is less than half of the NAAQS 24-hour SO_2 concentration of 365 ug/m^3. Thus, air concentrations of SO_2 are not anticipated to pose a risk to users at the proposed sports complex.

4.1.8 Findings for criteria pollutant analysis

A series of analyses were conducted to assess the potential air quality impacts of criteria pollutants on the proposed sports complex. The analyses gradually increased in the degree of sophistication and resolution as required to assess the potential impacts from surrounding sources. The Level I screening analyses investigated only those sources located directly to the south and southeast and in close proximity of the site. The cavity zone analysis showed that the buildings and stacks at Midwest Generation's Waukegan Generating Station would not create plume downwash. However, the maximum impact screening analysis indicated that the WGS sources could influence air concentrations to varying degrees at the site.

To better assess the degree and duration of these air concentrations, a more detailed screening modeling analysis was conducted. The Level II analysis increased the number of sources investigated with a focus on those sources located to the south of the proposed sports complex. The resulting concentrations, when combined with background concentrations obtained from an IEPA's monitoring sites, showed that CO and SO_2 were not of concern, but the predicted concentrations of PM_{10} were questionable when compared with the NAAQS. In addition, NO_2 concentrations were also found to be elevated when compared with the California one-hour standard.

To confirm the findings of the Level II analysis, a Level III analysis was conducted. The Level III analysis considered all wind directions over a five-year period of meteorological data and included all major sources of criteria pollutants located within five miles of the proposed sports complex. Prior to conducting the Level III analysis, we consulted with major facilities in the area to provide the opportunity to review their source data to confirm its accuracy. After revisions were received from several sources the models were updated to reflect the best available information. Final refined runs were then made to assess the potential concentrations that could be expected to occur at the proposed sports complex. The results showed that short-term CO, PM_{10}, Lead, and SO_2 concentrations, when combined with their corresponding background concentrations and compared to the appropriate NAAQS, should not pose a risk to users at the site. Annual NO_2 concentrations were also found to be in compliance with the corresponding NAAQS. Furthermore, although short-term NO_2 concentrations were found to exceed a California standard, the likelihood that the predicted exceedances will occur in the future is extremely remote and, even if they do occur, they would not contribute unacceptably to increased risk for future park users.

4.2 Non-criteria Pollutant Analysis

This section presents the findings from a screening-level assessment of potential risks to children recreational users[3] of WPD's proposed sports complex who may be exposed to non-criteria pollutants emitted from 20 facilities in the Waukegan, IL area. These findings include estimates of acute risks and chronic risks for both cancer and non-cancer effects to children who may be exposed while playing at the proposed sports complex. Using established exposure and risk assessment procedures and an EPA-approved air dispersion model, we evaluated the potential inhalation hazards attributable to emissions of 56 chemicals from 20 facilities that were identified within a

---

[3] Because children weigh less than adults and because the breathing rate for children exercising is greater than for adults at rest, focusing this evaluation on children is expected to be conservative for adult exposures at the WPD. Thus, adult exposures are considered to be addressed by default.

5 mile radius of the location of the proposed sports complex. For details concerning the identification and selection of facilities for consideration, see Sections 3.1 and 4.1.2.

Risks were evaluated by: (1) collecting emissions inventory data to identify chemicals emitted by nearby facilities and estimating emission rates; (2) modeling air dispersion from identified sources to the location of the sports complex to estimate airborne exposure concentrations; and (3) assessing potential acute and chronic risks to children who may be exposed, by comparing exposure concentration estimates to appropriately matched toxicity criteria for each chemical considered. The appropriately matched toxicity criteria (which were derived from published information) were also adjusted for the estimated duration and frequency of exposure appropriate for this study and for the differences between adult and child breathing rates and body weights (relative to the default values from which the original toxicity criteria are derived).

This section describes the procedures used to conduct the risk screening for non-criteria pollutants as well as the findings. A "screening-level" assessment is intended to be conservative. Thus, predicted concentrations and exposures are likely to be higher than concentrations (or at least the average concentrations) that may actually occur at the site being modeled. Also, the multiple contributions to risk are combined in a conservative manner that assumes additivity of risks. Overall, this method should provide a conservative (protective) estimate of the potential risks at the proposed facility. If the predicted risks from a screening-level assessment are unacceptably high, then the appropriate next step is to conduct a more rigorous risk assessment and/or conduct monitoring to confirm the results before risk management decisions are made. In contrast, because of the conservative nature of the screening-level approach, if predicted risks are low, then there is confidence that there is no cause for concern and more rigorous analysis is not required.

The remaining subsections of this section present, respectively, descriptions of the source data, air dispersion modeling, exposure and toxicity assessments, risk characterization, and our findings. Risk estimates are also summarized in tables. More detailed presentation of the acute and chronic risks posed by chemical emissions and the model outputs for each facility included in this analysis, are presented in a set of appendices.

4.2.1 Source data

Emissions data for the 20 sources that were identified within a 5-mile radius of the proposed sports complex site (Sections 3.1 and 4.1.2) were used as the basis for this assessment. Most of these data were obtained from the Illinois Environmental Protection Agency (IEPA) and are believed to represent the most current of data available. The data were used as provided; we did not review the data for completeness or accuracy. IEPA collected these data from EPA's Toxics Release Inventory (TRI), permits, and other air emissions data sources. Most of the emissions data were provided in December, 2000. However, chromium emissions data from Dexter Corp. were updated in April, 2001. In addition, emissions data for Midwest Generation for mercury, polycyclic aromatic compounds (PACs), and dioxins and related compounds were added to the analysis in June, 2001 (Appendix C). These emission rates were derived using an emission factor approach presented in EPA guidance documents (U.S. EPA, 2000c; U.S. EPA, 2001a). Finally, new emissions and stack parameter data (obtained from Clean Air Act Title V permits and the Toxics Release Inventory) were added in September 2001 for Outboard Marine Corp./Bombardier and Abbott Labs (Appendix C).

The source inventory data provide annual emissions estimates for a variety of industrial manufacturers, power plants, and other facilities with chemical emissions in the Waukegan area that were located within about 5 miles of the proposed sports complex. Included in the inventory were both stack and fugitive emissions data, where available, from each of the 20 sources. In our assessment, stack and fugitive emissions were evaluated both separately and together. Based on the inventory data, 56 chemicals are emitted by the sources identified, including a variety of metals and organic compounds. It should be noted that multiple forms of the same chemicals are reported in the various indices (e.g., both copper and copper compounds are reported and xylenes are reported both as total, mixed xylenes and as individual xylene isomers). To simplify reporting of our findings, we present the emissions data for each chemical in the same form for which the available toxicity data are reported. For example, xylenes are reported in four different ways, however the available toxicity data are reported for "mixed xylenes", so we simplified the presentation of the emissions data for xylenes by similarly reporting combined emissions for mixed xylenes. Because the same toxicity values are applied to pure metals and their associated compounds, we report metals emissions as emissions of metals in their equivalent, elemental form. Additional discussion of the toxicity data are presented in Section 4.2.4. Emissions data for non-criteria pollutants are summarized in Table 4-2.

4.2.2 Dispersion modeling

The air dispersion modeling procedures used for this assessment are established methods used by EPA and other organizations to provide screening-level estimates of air concentrations that might result from facility stack and fugitive emissions. Air dispersion models are the primary tools used to simulate the chemical and physical processes in the atmosphere that affect the movement of pollutants from the source to the receptor. They can account for stack characteristics, local terrain, meteorology, and other factors that influence the concentrations of chemicals in air. SCREEN3 is an EPA model that incorporates source-related factors to estimate ambient pollutant concentrations. SCREEN3 performs single source calculations, estimating the maximum 1-hour concentrations at pre-specified distances. These 1 hour maximums are directly used in the acute effects assessment and are also converted to maximum annual average concentrations for chronic effects assessments.

Table 4-2 Non-Criteria Pollutant Emissions Data Summary

Facility Name	Source Location (Refer to Fig. 3-4)	Non-criteria Pollutant	Chemical Abstract System No.	Fugitive Emissions lb/yr	Stack Emissions lb/yr
Abbott Labs - Boiler 7	13	Mercury Compounds	7439976	0	15
Abbott Labs - Boiler 7	13	Dioxins and Related Compounds (as I-TEQs)	1746016	0	1.20411E-05
Abbott Labs - Boiler 7	13	Hydrochloric acid	7647010	0	32000
Abbott Labs - S-32 Carbon Bed	13	Methylene chloride	75092	0	100000
Abbott Labs - S-32 Carbon Bed	13	Methanol	67561	499	1658
Abbott Labs - S-32 Carbon Bed	13	Di-2-ethylhexyl phthalate	117817	10	0
Avery-Dennison Commerical Products	30	Methylene Chloride	75092		248
BASF/ PPG Industries	27	Ethylene oxide	75218	1007	144
BASF/ PPG Industries	27	Propylene Oxide	75569	175	55
BASF/ PPG Industries	27	Methanol	67561	15	27
BASF/ PPG Industries	27	Cresol (Mixed Isomers)	1319773	862	14
Cherry Electrical Products	3	Toluene	108883	5268	0
Coral Chemical Company	24	Hydrogen Fluoride	7664393	499	499
Coral Chemical Company	24	Glycol Ethers	10230	499	499
Cosmed of Illinois	20	Ethylene Oxide	75218	1800	3300
Dexter Corporation/Akzo Nobel	9	Ethylbenzene	100414	25	41
Dexter Corporation/Akzo Nobel	9	Methyl isobutyl ketone	10801	959	996
Dexter Corporation/Akzo Nobel	9	Toluene	108883	5157	5354
Dexter Corporation/Akzo Nobel	9	Phenol	108952	1	8
Dexter Corporation/Akzo Nobel	9	Xylene (Mixed Isomers)	1330207	5460	5577
Dexter Corporation/Akzo Nobel	9	Formaldehyde	50000	27	4
Dexter Corporation/Akzo Nobel	9	N,N-Dimethylformamide	68122	736	736
Dexter Corporation/Akzo Nobel	9	N-Butyl Alcohol	71363	3053	3131
Dexter Corporation/Akzo Nobel	9	Methyl Ethyl Ketone	78933	7365	7681
Dexter Corporation/Akzo Nobel	9	4,4' -Isopropylidenediphenol	80057	94	846
Dexter Corporation/Akzo Nobel	9	N-Methyl-2-Pyrrolidone	872504	450	458
Dexter Corporation/Akzo Nobel	9	Glycol Ethers	10230	5527	5639
Dexter Corporation/Akzo Nobel	9	Diisocyanates	10120	0	511
Dexter Corporation/Akzo Nobel	9	Barium Compounds	10040	0	299
Dexter Corporation/Akzo Nobel	9	Zinc Compounds	10982	0	142
Dexter Corporation/Akzo Nobel	9	Chromium Compounds	10090	0	1.72
Domino Amjet Inc.	29	Methyl Ethyl Ketone	78933		5250
Domino Amjet Inc.	29	Methanol	67561		2625
Emco Chemical Distributors, Inc.	15	N-Butyl Alcohol	71363	11	58
Emco Chemical Distributors, Inc.	15	Dibutyl Phthalate	84742	27	0

Table 4-2 Non-Criteria Pollutant Emissions Data Summary

Facility Name	Source Location (Refer to Fig. 3-4)	Non-criteria Pollutant	Chemical Abstract System No.	Fugitive Emissions lb/yr	Stack Emissions lb/yr
Emco Chemical Distributors, Inc.	15	Dichloromethane	75092	1345	3329
Emco Chemical Distributors, Inc.	15	Ethylbenzene	100414	56	16
Emco Chemical Distributors, Inc.	15	Glycol Ethers	10230	36	0
Emco Chemical Distributors, Inc.	15	N-Hexane	110543	80	428
Emco Chemical Distributors, Inc.	15	Hydrochloric Acid	7647010	4	0
Emco Chemical Distributors, Inc.	15	Isopopyl Alcohol	67630	291	443
Emco Chemical Distributors, Inc.	15	Methanol	67561	226	227
Emco Chemical Distributors, Inc.	15	Methyl Ethyl Ketone	78933	393	781
Emco Chemical Distributors, Inc.	15	Methyl Isobutyl Ketone	108101	169	90
Emco Chemical Distributors, Inc.	15	Naphthalene	91203	21	2
Emco Chemical Distributors, Inc.	15	Tetrachloroethylene	127184	14	0
Emco Chemical Distributors, Inc.	15	Trichloroethylene	79016	155	195
Emco Chemical Distributors, Inc.	15	1,2,4-Trimethylbenzene	95636	46	19
Emco Chemical Distributors, Inc.	15	Toluene	108883	482	471
Emco Chemical Distributors, Inc.	15	Xylene (Mixed Isomers)	1330207	374	107
Fansteel/Federal Die Casting Company	17	Aluminum	7429905	939	8450
Gallagher Corporation	28	Formaldehyde	5000		0.24
Gallagher Corporation	28	4,4-Methylene dephenyl diisocyante	101688		0.018
Gallagher Corporation	28	Phenol	108952		82
Gallagher Corporation	28	Trichloroethylene	79016		3300
Gallagher Corporation	28	Toluene	108883		4820
Gillette Co. - N. Chicago Plant	18	Ammonia	7664417	25	270
Gillette Co. - N. Chicago Plant	18	Hydrochloric Acid	7647010	10	1500
Gillette Co. - N. Chicago Plant	18	Methanol	67561	10	12000
Midwest Generation	1	Chromium Compounds	10090		360
Midwest Generation	1	Copper Compounds			380
Midwest Generation	1	Sulfuric Acid	7664939		45000
Midwest Generation	1	Hydrogen Chloride	7647010		215000
Midwest Generation	1	Hydrogen Fluoride	7664393		300000
Midwest Generation	1	Lead	7439921		27280
Midwest Generation	1	Manganese Compounds			1110
Midwest Generation	1	Dioxins and Related Compounds (as I-TEQs)			1.25E-03
Midwest Generation	1	Mercury			629.4
Midwest Generation	1	PACs			9.2
Midwest Generation	1	Nickel Compounds			470

Table 4-2 Non-Criteria Pollutant Emissions Data Summary

Facility Name	Source Location (Refer to Fig. 3-4)	Non-criteria Pollutant	Chemical Abstract System No.	Fugitive Emissions lb/yr	Stack Emissions lb/yr
Outboard Marine Corp./Bombardier - Plant 1	6	Crotonaldehyde	123739	0	0.876
Outboard Marine Corp./Bombardier - Plant 1	6	Xylene (mixed isomers)	1330207	0	7971.6
Outboard Marine Corp./Bombardier - Plant 1	6	2,2,4-Trimethylpentane	540841	0	77.088
Outboard Marine Corp./Bombardier - Plant 1	6	Methyl tert-butyl ether	1634044	0	205360
Outboard Marine Corp./Bombardier - Plant 1	6	Methyl ethyl ketone	78933	0	27788.88
Outboard Marine Corp./Bombardier - Plant 1	6	Hexane	110543	0	21354.164
Outboard Marine Corp./Bombardier - Plant 1	6	Glycol ethers	10230	0	19885.2
Outboard Marine Corp./Bombardier - Plant 1	6	Formaldehyde	50000	0	9568.908
Outboard Marine Corp./Bombardier - Plant 1	6	Ethylbenzene	100414	0	39629.784
Outboard Marine Corp./Bombardier - Plant 1	6	Cumene	98828	0	2200
Outboard Marine Corp./Bombardier - Plant 1	6	O-Xylene	1330207	0	33980.444
Outboard Marine Corp./Bombardier - Plant 1	6	Propionaldehyde	123386	0	660.876
Outboard Marine Corp./Bombardier - Plant 1	6	Acetaldehyde	75070	0	1750.512
Outboard Marine Corp./Bombardier - Plant 1	6	Acrolein	107028	0	662.628
Outboard Marine Corp./Bombardier - Plant 1	6	Benzene	71432	0	10014.312
Outboard Marine Corp./Bombardier - Plant 1	6	Toluene	108883	0	81039.728
Outboard Marine Corp./Bombardier - Plant 1	6	Chromium compounds	18540299	0	97.236
Outboard Marine Corp./Bombardier - Plant 1	6	1,3-Butadiene	106990	0	3105.7
Outboard Marine Corp./Bombardier - Plant 1	6	M & P Xylene	1330207	0	92000
Outboard Marine Corp./Bombardier - Plant 1	6	P-Xylene	1330207	0	72.708
Outboard Marine Corp./Bombardier - Plant 2	5	Xylene (mixed isomers)	1330207	0	25798.2
Outboard Marine Corp./Bombardier - Plant 2	5	Ethylbenzene	100414	0	1883.4
Outboard Marine Corp./Bombardier - Plant 2	5	Glycol ethers	10230	0	14454
Outboard Marine Corp./Bombardier - Plant 2	5	Di-2-ethylhexyl phthalate	117817	0	1839.6
Outboard Marine Corp./Bombardier - Plant 2	5	Manganese	7439965	0	343.36
Outboard Marine Corp./Bombardier - Plant 2	5	Methanol	67561	0	1664.4
Outboard Marine Corp./Bombardier - Plant 2	5	Toluene	108883	0	5869.2
Outboard Marine Corp./Bombardier - Plant 2	5	Chromium	7440473	0	163.68
Outboard Marine Corp./Bombardier - Plant 2	5	Methyl ethyl ketone	78933	0	72357.6
Outboard Marine Corp./Bombardier - Plant 2	5	Methyl isobutyl ketone	108101	0	9329.4
Outboard Marine Corp./Bombardier - Plant 2	5	Dibutyl phthalate	84742	0	1883.4
Outboard Marine Corp./Bombardier - Plant 2	5	Nickel	7440020	0	117.88
Pfanstiehl Laboratories Inc.	22	Methanol	67561	0	6477
Pfanstiehl Laboratories Inc.	22	N-Hexane	110543	0	1498
Pfanstiehl Laboratories Inc.	22	Acetonitrile	75058	0	142

Table 4-2 Non-Criteria Pollutant Emissions Data Summary

Facility Name	Source Location (Refer to Fig. 3-4)	Non-criteria Pollutant	Chemical Abstract System No.	Fugitive Emissions lb/yr	Stack Emissions lb/yr
Pfanstiehl Laboratories Inc.	22	Toluene	108883	0	96
Provena Hospitals D/B/A St. Therese Med. Ctr.	23	Ethylene Oxide	75218		262
R. Lavin & Sons, Inc.	16	Zinc compounds	10982	16000	26000
R. Lavin & Sons, Inc.	16	Copper	7440508	240	430
R. Lavin & Sons, Inc.	16	Lead	7439921	1800	3000
R. Lavin & Sons, Inc.	16	Manganese	7439965	3	5
R. Lavin & Sons, Inc.	16	Nickel	7440020	3	5
Roquette America, Inc.	26	Nickel	7440020	10	499
Stone Container Corp. - N. Chicago Plant	14	Vinyl Acetate	108054		122
Stone Container Corp. - N. Chicago Plant	14	Hydroquinone	123319		1
Stone Container Corp. - N. Chicago Plant	14	Ethyl Acrylate	140885		0.6
Stone Container Corp. - N. Chicago Plant	14	Acetaldehyde	75070		12
Stone Container Corp. - N. Chicago Plant	14	Formaldehyde	50000		60
Stone Container Corp. - N. Chicago Plant	14	Glycol Ethers	10230		300
Stone Container Corp. - N. Chicago Plant	14	Hexane	110543		0.16
Stone Container Corp. - N. Chicago Plant	14	Methonal	67561		290
Stone Container Corp. - N. Chicago Plant	14	Styrene	100425		12
Stone Container Corp. - N. Chicago Plant	14	Toluene	108883		6
Victory Memorial Hospital	25	Ethylene Oxide	75218		0.2

This assessment focuses on air emissions and inhalation as the primary route of exposure. Using the emission rates described above for stack and fugitive emissions from the 20 facilities under evaluation, we used SCREEN3 to predict resulting airborne concentrations at the proposed sports complex. Distances from each facility to the sports complex were calculated from Universal Transverse Mercator (UTM) data provided as part of the emissions inventory and generally ranged between about ½ mile and 5 miles. One of the conservative elements of SCREEN3 is the assumption that the predominant wind direction is always from the location of each source to the receptor.

Input parameters needed to run SCREEN3 are listed below. When provided by facility staff or otherwise available, facility-specific values (particularly stack data) were used to evaluate exposure. When facility-specific values were unavailable, generic/default values assumed representative of the relevant scenarios were used.

The main facility-specific input values include:

- Source emission rate (for stack and fugitive emissions);
- Stack height (for stack emissions);
- Inside stack diameter (for stack emissions);
- Exhaust gas exit velocity (for stack emissions);
- Exhaust gas exit temperature (for stack emissions);and
- Distance to receptor (for stack and fugitive emissions).

Stack parameters for fugitive emissions were generic for all facilities. Other parameters for which generic values were used for modeling stack and fugitive emissions from all facilities are:

- land use near the modeled facility;
- terrain features near the facility; and
- meteorological classification.

Because all facilities are at least ½ mile from the proposed sports complex, no modeling of downwash effects was conducted. The parameter values we used for modeling each facility are presented in Appendix C.

In most cases, assumptions were made that all emissions were emitted from one stack at each facility, with reported stack parameters that are assumed to be representative, which is standard for screening-level assessments. In a few exceptions, facility emissions were modeled from multiple stacks within a facility, such as Dexter (two separate stacks for chromium emissions), Abbott Labs (two stacks from different types of operations), and Outboard Marine Corp./Bombardier (two stacks for two separate plants within the facility). For Outboard Marine Corp./Bombardier, which actually has 15 stacks, the following procedure was used to select two sets of stack parameters that would be representative of the stacks at each plant. For each set of stacks, the emissions are the total emissions from all stacks of a given pollutant, the stack height is the average height of all the stacks, the stack diameter used is the average diameter of all the stacks, and the stack exit velocity is the average of all the stack velocities. The representative stack temperature was calculated as a weighted average, based on the absolute temperature of each stack, multiplied by the exit velocity of that stack. The sum of these values was divided by the sum of all exit velocities of the stacks in the set.

The standard output from SCREEN3 is the 1-hour maximum concentration in the predominant downwind direction at the receptor distance from the stack specified by the user. This value was used directly for the acute effects assessment. For long term (chronic) exposures and effects, this value was converted, using a conservative conversion factor developed by the U.S. EPA, to an estimated maximum concentration for an annual averaging time. This factor is intended to be used for a general case with a degree of conservatism to assure that the maximum annual average concentrations are not underestimated.

4.2.3 Exposure estimation

As previously indicated, the exposure pathway addressed in this study is the inhalation pathway for a recreational exposure scenario involving children playing soccer at the sports complex. This pathway includes the following elements: emissions of specific contaminants by sources within approximately 5 miles of the proposed sports complex; transport of such contaminants by wind dispersion; and the potential for inhalation of contaminants by children playing at the proposed sports complex.

To evaluate risk, airborne chemical concentrations are estimated as described in the previous section and are compared to appropriate toxicity critieria for each toxic end point of interest. As previously indicated, the toxicity criteria used in this study were modified to account for the duration and frequency of exposure and for differences between adult and child breathing rates and body weights. The toxicity criteria used in this assessment of non-criteria pollutants are described in Section 4.2.4 and the resulting risk characterization in Section 4.2.5. The factors used to adjust toxicity criteria exposure duration and frequency and for breathing rate and body weight are described below.

The toxicity criteria used by EPA are adjusted in this evaluation to account for differences in the characteristics of intake that are assumed as defaults by EPA and the site-specific values for inhalation rate, days per year exposure, and children's (as opposed to adult) body weight that are appropriate for evaluating risk to users of the proposed sports complex. The site-specific exposure factors used in this assessment are listed in Table 4-3. Typically, these factors are assumed to affect toxicity criteria in a linear fashion. Thus, for example, an RfC appropriate for lifetime, continuous exposure would be adjusted for 2-hrs per day exposure by dividing the RfC by a factor of 2/24 where the denominator is simply the number of hours in a day. This is standard practice.

Table 4-3: Site-Specific Exposure Factors

Exposure Factor	Input Value	Units
Receptor	Child Soccer Player	None
Inhalation Rate	1.9*	cu m/hr
Exposure Frequency 1	50	days/yr
Exposure Frequency 2	2	hours/day
Exposure Duration	10	years
Body Weight	41.1**	kg

* Recommended inhalation rate for children (aged 18 years and under) for heavy activities from EPA's *Exposure Factors Handbook* (U.S. EPA, 1997a)

** The mean body weight of 11-year old children (U.S. EPA, 1997a).

4.2.4 Toxicity Assessment

The toxicity of chemicals to which a person may be exposed is a key factor in determining the relationship between the exposure and the probability of the occurrence and severity of an adverse health effect. The toxicity assessment, including the dose-response assessment, considers: (1) the types of adverse health effects associated with chemical exposures; (2) the relationships between magnitudes of exposures and potential adverse effects; and (3) related uncertainties such as the weight of evidence of a particular chemical's toxicity to humans.

In this case, we retrieved relevant toxicity criteria for the chronic (cancer and non-cancer) effects assessment as well as the acute effects assessment. Benchmark values were used to assess acute effects, Reference Concentrations (RfCs) were used for assessing non-cancer effects, and carcinogenic unit risk factors were used to assess cancer effects. There were 56 chemicals identified in the emissions data inventory. It should be noted that multiple forms of chemicals were reported (e.g., xylenes were reported both as total mixed xylenes as well as individual isomers), so some simplification was performed on the data for this assessment. In addition, facilities reported data for metal compounds in different ways (e.g., reported as both copper and copper compounds). The same toxicity values were chosen for the metals and metal compounds. For chromium emissions data, it was assumed that it was present in the more toxic hexavalent form to assure that our analysis would be health protective[4].

Sources of Toxicity Criteria

A search was performed to obtain relevant toxicity criteria for each of the 56 chemicals previously identified as being emitted from sources in the area. The main toxicity criteria searches were performed in December 2000, with periodic updates as new chemicals were added to the assessment in June, September, and October 2001. Chronic toxicity criteria (either the required RfCs and slope factors or other criteria from which RfCs and slope factors can be derived in a straightforward manner, see Section 3.3.1) are available for 49 of the 56 chemicals included in the emissions inventory. The evaluation of hazards associated with the 49 chemicals for which appropriate criteria could be found is described in the next section. The remaining chemicals for which appropriate chronic toxicity criteria could not be found are considered further below.

The seven chemicals for which chronic (cancer and non-cancer) toxicity criteria could not be found within the government databases examined are: 2,2,4-trimethylpentane, hydrofluoric acid, isopropyl alcohol, lead, n-methyl-2-pyrrolidone, propionaldehyde, and sulfuric acid. However, all but two of these seven chemicals can be eliminated from further consideration because they are not generally considered toxic at low, environmental concentrations. Thus:

---

4 Chromium is a metal that can form stable compounds in a variety of oxidation (valence) states; the oxidation state determines the number of other atoms or ligands (combinations of associated atoms) that the metal binds to. The toxicity of chromium is known to be a strong function of the metal's oxidation state with the highest oxidation state (hexavalent chromium) being the only state of chromium known to be carcinogenic.

- 2,2,4-trimethylpentane is a branched, saturated alkane. Organic chemicals of this type constitute the major components of gasoline and are not considered toxic at low levels of exposure. Thus, 2,2,4-trimethylpentane is not considered further in this study;

- hydrofluoric acid (HF) is an inorganic acid manufactured in moderate volumes and used in a broad range of manufacturing processes. It also occurs as a minor bi-product of coal combustion. Although acutely hazardous at high concentrations, at the kinds of concentrations relevant to this study, it is not expected to contribute substantially to risk. Therefore, HF is not considered further;

- isopropyl alcohol (C_3H_7OH) is widely available as non-prescription "rubbing" alcohol and exposure at the levels estimated in this study are not considered hazardous so that isopropyl alcohol is not addressed further;

- lead (Pb) is addressed directly in this study as one of the criteria pollutants and bulk concentrations in soils and other bulk matrices surrounding the proposed sports complex are also evaluated in comparison with various regulatory standards and criteria that have been developed to control lead emissions from fugitive sources (Section 5.5). Therefore, lead need not be further addressed as a non-criteria pollutant in this section;

- sulfuric acid (H_2SO_4) is an inorganic acid manufactured in large volumes and used in many commercial processes. While, at high concentrations, the acid is an acute hazard, at the concentrations anticipated in this study, it is not expected that sulfuric acid will contribute substantially to risk. Therefore, this chemical is not further addressed.

The two remaining chemicals for which no chronic toxicity criteria could be located are propionaldehyde and N-methyl-2-pyrrolidone. N-methyl-2-pyrrolidone is a high-boiling solvent used in various manufacturing processes. It also serves as an intermediate in the manufacture of various polymers. This chemical is not currently scheduled for toxicological evaluation by the USEPA so that it does not appear to be raising immediate concern as a hazard. Therefore, because the exposure concentrations estimated for this chemical in this study are comparable to many of the other hazardous chemicals evaluated (for which chronic toxicity criteria exist) and because none of these other hazardous materials are shown to contribute unacceptably to risk at such concentrations, it is unlikely that N-methyl-2-pyrrolidone will present an unacceptable hazard to users of the proposed sports complex. Thus, this chemical is not further evaluated in this study.

Propionaldehyde is a small, partially oxygenated alkane that has been identified as a component of cigarette smoke, among other things. Although, chronic toxicity studies have not been conducted for this molecule, it is generally considered an irritant at low concentrations (rather than a chronic toxin), which does not suggest extreme or unusual toxicity. Therefore, because the exposure concentrations estimated for this chemical in this study are comparable to many of the other hazardous chemicals evaluated (for which chronic toxicity criteria exist) and because none of these other hazardous materials are shown to contribute unacceptably to risk at such concentrations, it is unlikely that propionaldehyde will present an unacceptable hazard to users of the proposed sports complex. Thus, this chemical is not further evaluated in this study.

Among chemicals for which toxicity criteria could be found, a tiered approach was used to select the most appropriate chronic toxicity values from four EPA sources for the chemicals of concern. In priority order they were: EPA's Integrated Risk Information System (IRIS) (U.S. EPA, 2000a), followed by EPA's Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1997b), provisional EPA/NCEA criteria as reported in EPA Region 3's Risk-Based Concentration Table (U.S. EPA, 2000b), and

EPA Region 9 Preliminary Remediation Goals (PRGs) toxicity values (U.S.EPA, 2001b). Acute benchmark values for 23 chemicals were collected from two sources: the Agency for Toxic Substances and Disease Registry (ATSDR) and the California Office of Environmental Health Hazard Assessment (COEHHA).

IRIS contains toxicity criteria, including Reference Doses (RfDs), Reference Concentrations (RfCs), cancer slope factors, and unit risk factors for more than 500 chemicals and is the result of Agency-wide consensus on toxicity criteria to be used in risk assessments, decision-making, and regulatory activities (U.S. EPA, 2000a). IRIS contains toxicological information on non-cancer and cancer health effects and consolidates EPA's human health risk and regulatory information for these chemicals in an electronic database which can be accessed at http://www.epa.gov/docs/ngispgm3/iris/index.html.

HEAST (U.S. EPA, 1997b), prepared by EPA's National Center for Environmental Assessment (NCEA), consolidates human health risk information for chemicals of interest to the Superfund program, RCRA program, and EPA in general. Information contained in HEAST is gathered from documents developed by EPA offices for specific chemicals. HEAST provides chronic and subchronic non-cancer toxicity criteria such as inhalation RfCs and oral RfDs. HEAST also provides cancer slope factors and unit risk factors.

Six of the chemicals evaluated in this study were reported as chemical groups: cresols, glycol ethers, diisocyanates, dioxins and related compounds, xylenes, and polycyclic aromatic compounds (PACs). The toxicity criteria for cresol-mixed isomers were used to characterize the toxicity of cresols. For dioxins and related compounds, the emissions data provided congener-specific results for the 17 compounds of concern, thus a toxic equivalent mass (TEq) of 2,3,7,8-TCDD was calculated using the World Health Organization Toxicity Equivalency Factor (WHO TEF) approach. For PACs, the total mass of all six PACs was assumed to be the most toxic individual compound, benzo(a)pyrene. Toxicity criteria for the xylene isomers were based on available data on mixed xylenes. A description on how toxicity data for glycol ethers and diisocyanates were selected is discussed later in this section.

RfC toxicity criteria were not available for all chemicals. In select cases, the RfC was derived from one of the following sources: an inhalation RfD from HEAST, NCEA provisional RfDs reported by NCEA/Cincinnati and used by Region 3 for the derivation of risk-based concentrations (RBCs), from an oral RfD from IRIS (U.S. EPA, 2000b), or from EPA Region 9 Preliminary Remediation Goals toxicity values (U.S. EPA, 2001b). The inhalation RfD can be used to calculate an RfC by taking the RfD and multiplying it by 70 kg body weight and then dividing by an inhalation rate for adults of 20 m^3/day. Inhalation RfDs were used to derive RfCs for 1,2,4-trimethylbenzene, aluminum, and barium. When an inhalation RfD value is not available, an oral RfD value can be used as a last resort. However, the use of the oral RfD increases the level of uncertainty. The use of an oral RfD to derive an RfC was required for 4,4'-isopropylidenediphenol, butyl alcohol, copper, nickel, xylenes, and zinc.

For some chemicals, the inhalation unit risk factors were derived using the inhalation slope factor from IRIS or HEAST. When the inhalation slope factor was not available, the oral slope factor was used. The use of an oral slope factor in the derivation of the inhalation unit risk does increase the level of uncertainty. An oral slope factor was used to derive unit risk factors for benzo(a)pyrene and crotonaldehyde. The slope factor can be used to calculate an inhalation unit risk by multiplying the slope factor by the inhalation rate of an adult (20 m^3/day), dividing this by the product of the body weight (70 kg) multiplied by a conversion factor (1000 μg/mg).

Derivation of Appropriate Chronic Toxicity Benchmarks

For glycol ethers and diisocyanates it was necessary to select a representative chemical from each group on which toxicity data would be gathered for the assessment. The following is a discussion explaining which chemicals were chosen and why.

In January 1999, EPA issued a Federal Register notice (FR 64:1780-1784) proposing to delete higher molecular weight glycol ethers from the Clean Air Act Hazardous Air Pollutant (HAP) list as well as the list of hazardous substances from the Superfund program. The logic included an assumption that the lowest molecular weight glycol ethers (i.e., 2-methoxyethanol and 2-ethoxyethanol) are the most toxic glycol ethers and that toxicity decreases as molecular weight increases. Using that type of logic, we made a very conservative assumption that all emissions reported as "glycol ethers" are 2-methoxyethanol.

One of the 20 facilities reported emissions of diisocyanates but did not specify which specific diisocyanate compound(s) was emitted. EPA has evaluated 4 diisocyanates in IRIS. None have been classified by EPA for carcinogenicity but EPA has developed RfCs for 3 of the 4. Acute ATSDR MRLs and acute COEHHA RELs have not been developed for any of the four. The chemical with the most stringent RfC is hexamethylene-1,6-diisocyanate. So, as a conservative approach, we used the RfC value for hexamethylene-1,6-diisocyanate for the diisocyanates.

Table 4-4 provides the available inhalation unit risk factors, RfCs, and cancer slope factors for the chemicals in the assessment.

Acute Benchmark Doses and Sources

Benchmark dose concentrations are chemical-specific criteria developed by regulatory and/or scientific organizations that can be used to evaluate the potential for adverse health impacts from exposures to contaminants in various media. Benchmarks are usually derived from available toxicity data for a typical exposure scenario, based on default exposure parameters. As such, they should not be used as site-specific "safety" levels or for definitive assessments of human health impacts from chemical exposures. As previously indicated, they are typically applied at specific sites by calculating hazard quotients (HQs) and a safety factor is then applied when making decisions based on such quotients (see Section 3.3.1). The RfCs can be considered to be one example of

Table 4-4: Toxicity Data for Chemicals of Concern

CAS Number	Chemical Name	UNIT_CAR inh unit risk (1/mg/m3)	RFC chronic RfC (mg/m3)	CSF (1/mg/kg-day)	MRL-acute ATSDR ACUTE (mg/m3)	REL-acute CA/OEHHA REL (mg/m3)
95636	1,2,4-Trimethylbenzene		5.95E-03e			
106990	1,3-Butadiene	2.80E-01		9.80E-01		
540841	2,2,4-Trimethylpentane					
1746016	2,3,7,8-TCDD	4.3E+04a		1.5E+05		
80057	4,4' -Isopropylidenediphenol		1.75E-01f			
101688	4,4-Methylene diphenyl diisocyanate		6.00E-04			
75070	Acetaldehyde	2.20E-03	9.00E-03	7.70E-03		
75058	Acetonitrile		6.00E-02			
107028	Acrolein		2.00E-05		1.14E-04	1.90E-04
7429905	Aluminum		3.50E-03e			
7664417	Ammonia		1.00E-01		3.50E-01	3.2E+00
7440393	Barium		4.90E-04e			
71432	Benzene	2.20E-03		7.70E-03	1.59E-01	1.30E+00
50328	Benzo (a) pyrene	2.1E+00b		7.3E+00 (oral)		
71363	Butyl alcohol		3.5E-01f			
18540299	Chromium	1.20E+01	8.00E-06	4.20E+01		
7440508	Copper		1.40E-01g			1.00E-01
1319773	Cresol (Mixed Isomers)		1.75E-01			
123739	Crotonaldehyde	5.43E-01a		1.9E+0 (oral)		
98828	Cumene		4.00E-01			
117817	Di-(2-ethylhexyl) phthalate	4.00E-03b	7.00E-02	1.40E-02		
10120	Diisocyanates		1.00E-05			
84742	Dibutyl phthalate		3.50E-01			
140885	Ethyl acrylate	1.37E-02h		4.80E-02		
100414	Ethylbenzene		1.00E+00			
75218	Ethylene oxide	1.00E-01a		3.50E-01		
50000	Formaldehyde	1.30E-02		4.50E-02	4.90E-02	9.40E-02
10230	Glycol Ethers		2.00E-02			9.30E-02
110543	Hexane		2.00E-01			
7647010	Hydrochloric acid		2.00E-02			2.10E+00
7664393	Hydrofluoric acid					2.40E-01
123319	Hydroquinone		1.40E-01			

Table 4-4: Toxicity Data for Chemicals of Concern (Continued)

CAS Number	Chemical Name	UNIT_CAR inh unit risk (1/mg/m3)	RFC chronic RfC (mg/m3)	CSF (1/mg/kg-day)	MRL-acute ATSDR ACUTE (mg/m3)	REL-acute CA/OEHHA REL (mg/m3)
67630	Isopropyl alcohol					3.20E+00
7439921	Lead					
7439965	Manganese		5.00E-05			
7439976	Mercury (elemental, inorganic)		3.00E-04			1.8E-03
67561	Methanol		1.75E+00			2.80E+01
78933	Methyl ethyl ketone		1.00E+00			1.30E+01
108101	Methyl isobutyl ketone		8.00E-02			
1634044	Methyl tert-butyl ether (MTBE)		3.00E+00		7.21E+00	
75092	Methylene chloride	4.70E-04	3.00E+00	1.65E-03	1.04E+01	1.40E+01
68122	N,N-Dimethylformamide		3.00E-02			
91203	Napthalene		3.00E-03			
7440020	Nickel		7.00E-02g			6.00E-03
872504	N-Methyl-2-pyrrolidone					
108952	Phenol		2.10E+00			5.80E+00
123386	Propionaldehyde					
75569	Propylene oxide	3.70E-03	3.00E-02	1.30E-02		3.10E+00
100425	Styrene		1.00E+00			2.10E+01
7664939	Sulfuric acid					1.20E-01
127184	Tetrachloroethylene	5.71E-04c	3.50E-02	2.00E-03d	1.36E+00	2.00E+01
108883	Toluene		4.00E-01		1.51E+01	3.70E+01
79016	Trichloroethylene	1.71E-03c		6.00E-03d	1.07E+01	
108054	Vinyl acetate		2.00E-01			
1330207	Xylene (mixed isomers)		7.00E+00f		4.3E+00	2.20E+01
7440666	Zinc		1.05E+00f			

a - Inhalation unit risk for this value was calculated using the inhalation cancer slope value provided in HEAST, if an inhalation cancer slope was not available the oral cancer slope value was used.
b - Inhalation unit risk for this value was calculated using the oral cancer slope value provided in IRIS, if an inhalation cancer slope was not available the oral cancer slope value was used.
c - Inhalation unit risk for this value was calculated using the inhalation cancer slope value provided as a EPA-NCEA provisional value.
d - EPA-NCEA provisional value.
e - *RfC value is derived from the Region III RBC Table Inhalation RfD value.*
f - RfC value is derived from the IRIS oral RfD value.
g - RfC value is derived from the Region III RBC Table oral RfD value.
h - Inhalation unit risk for this value was calculated using the inhalation cancer slope factor value provided in EPA Region 9 PRG toxicity information.

a benchmark. Benchmarks used in this assessment for acute effects are described in the following paragraphs.

Acute Minimal Risk Levels (MRLs), which are derived by the Federal Agency for Toxic Substances and Disease Registry (ATSDR) using a procedure similar to that used by EPA to derive RfCs, were used in this assessment to evaluate acute effects. These MRLs can be obtained from ATSDR at http://www.atsdr.cdc.gov/mrls.html.

The COEHHA Acute Reference Exposure Levels (RELs) are established by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (COEHHA) for the Air Toxics "Hot Spots" program. An acute REL is an airborne level that is not likely to cause adverse effects to individuals in the general population (including sensitive subgroups) exposed for one hour to that level.

These RELs were accessed at http://oehha.ca.gov/air/acute_rels/allAcRELs.html. Table 4-4 provides the available acute MRLs and acute RELs for the chemicals in the assessment.

4.2.5 Risk Characterization

The final step in a risk assessment is risk characterization. This step combines information from the exposure and toxicity assessment steps. The quantitative assessment addresses risks from: (1) acute effects, (2) chronic non-cancer effects, and (3) cancer risks.

Acute Benchmark Comparison

Predicted 1-hour maximum concentrations were compared against two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the California Office of Environmental Health Hazard Assessment (COEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the Agency for Toxic Substances and

Disease Registry (ATSDR). This provides an approximation of the potential for adverse acute effects from inhalation. When the estimated ambient air concentrations are at or above the benchmark values, there is a possibility that individuals may be at risk (see Section 3.3.1).

Chronic Non-Cancer Risks

The risk characterization for chronic non-carcinogenic effects involves the calculation of hazard quotients (HQs) and hazard indices (HIs). A HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the RfC or Inhalation RfD developed by the U.S. EPA. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern. Adjustments to these calculations were made to account for differences between the site-specific exposure values selected for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The derivation of an RfC value by EPA includes assumptions of 20 cubic meters/day inhalation rate, 365 days/year exposure frequency, and 70kg body weight. It should be noted that the adjustments to the hazard index do not account for number of years of exposure because RfDs and RfCs are, by definition, based on exposure and effects over a lifetime (see Section 3.3.1).

Cancer Risks

For carcinogens, human health risks are expressed as a probability. Carcinogenic risk, expressed in scientific notation, is the probability of increased cancer incidence resulting from exposure to proven or suspected carcinogens. Generally, if the risk is greater than 1×10^{-6} to 1×10^{-4}, then a more detailed risk assessment should be performed. For an explanation of the meaning of this risk range, see Section 3.3.1 For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the unit risk factor. A unit risk factor is in units of 1/concentration, such as 1/(mg/cu m), so that multiplication of this unit risk by a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the hazard quotient, the sum of the comparisons against benchmarks for all facilities and all chemicals were 0.87 (compared to the REL) and 1.24 (compared to the MRL). Values for other chemicals were substantially lower, from about one percent of the benchmark to six or seven orders of magnitude below levels of concern. See Table 4-5 for a summary of the acute effects assessment.

As indicated above, the index for acute hazards estimated for non-criteria pollutants in this study slightly exceeds one of the two benchmarks employed in this study for comparison; it is slightly lower than the other. In both cases, however, the quotients exceed the value of 0.5 generally favored by regulatory agencies as an action level. Therefore, at this point in time, we cannot assure that emissions from Outboard Marine/Bombardier will not lead unacceptably to adverse health effects at the proposed sports complex. Before a final determination is made concerning such emissions, it is strongly recommended that emission estimates from these facilities be reevaluated. If the emission estimates are confirmed to be accurate, then a more sophisticated (Level III) analysis should be performed to determine whether emissions from these two facilities may in fact contribute unacceptably to acute hazards at the proposed sports complex.

<u>Non-Cancer Hazards</u>

Chronic non-cancer risks to children are estimated to be well below levels of concern (hazard index of 0.5), with a total hazard index of 0.098 (sum of all chemicals and facilities). The highest hazard indices were 0.064 for Outboard Marine Corp./Bombardier (mostly from acrolein and chromium emissions) and 0.030 from Dexter Corporation (mostly diisocyanate emissions). The remaining 15 facilities for which non-cancer hazards could be assessed were three to eight orders of magnitude below levels of concern. The highest hazard quotients from individual chemicals included: diisocyanates (0.029), chromium (0.032) and acrolein (0.024).

a benchmark. Benchmarks used in this assessment for acute effects are described in the following paragraphs.

Acute Minimal Risk Levels (MRLs), which are derived by the Federal Agency for Toxic Substances and Disease Registry (ATSDR) using a procedure similar to that used by EPA to derive RfCs, were used in this assessment to evaluate acute effects. These MRLs can be obtained from ATSDR at http://www.atsdr.cdc.gov/mrls.html.

The COEHHA Acute Reference Exposure Levels (RELs) are established by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (COEHHA) for the Air Toxics "Hot Spots" program. An acute REL is an airborne level that is not likely to cause adverse effects to individuals in the general population (including sensitive subgroups) exposed for one hour to that level.

These RELs were accessed at http://oehha.ca.gov/air/acute_rels/allAcRELs.html. Table 4-4 provides the available acute MRLs and acute RELs for the chemicals in the assessment.

4.2.5 Risk Characterization

The final step in a risk assessment is risk characterization. This step combines information from the exposure and toxicity assessment steps. The quantitative assessment addresses risks from: (1) acute effects, (2) chronic non-cancer effects, and (3) cancer risks.

Acute Benchmark Comparison

Predicted 1-hour maximum concentrations were compared against two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the California Office of Environmental Health Hazard Assessment (COEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the Agency for Toxic Substances and cancer risk given a lifetime of exposure at the specified concentration. Adjustments to these calculations were made to account for differences between the exposure values selected for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

4.2.6 Findings

Presented below are summaries of findings for children potentially exposed at the proposed sports complex. Overall, risks to children recreational receptors are generally below levels of concern. Total cancer risk from all facilities and all chemicals (5.72E-07) was below the 10^{-6} to 10^{-4} risk range. The highest cancer risks were from Outboard Marine Corp./Bombardier (5.31E-07). The highest risk chemicals were chromium (4.42E-07), 1,3-butadiene (8.90E-08), ethylene oxide (2.17E-08), and formaldehyde (1.28E-08). Non-cancer risks from the facilities were well below levels of concern (a total of 0.098) from all chemicals and facilities, with the highest values of 0.064 from Outboard Marine Corp./Bombardier and 0.030 from Dexter Corporation. The hazard indices from the other facilities were much smaller (ranging from three to eight orders of magnitude below levels of concern). For acute effects, most of the predicted 1-hour maximum concentrations were below the acute benchmarks. The exception was for acrolein emissions from Outboard Marine Corp./Bombardier, which was slightly above one of the acute benchmarks. More specific findings are presented below for acute effects as well as the cancer and non-cancer assessments for children.

Acute Effects

Comparisons of the predicted 1-hour maximum concentrations against acute benchmarks were used to assess the potential short term effects. Most of the predicted air concentrations (1-hour maximums) were below the acute benchmarks. The exception was for Outboard Marine Corp./Bombardier, where acrolein emissions exceeded the MRL (1.18) and approached the REL (0.705). Taken collectively, like a hazard quotient, the sum of the comparisons against benchmarks for all facilities and all chemicals were 0.87 (compared to the REL) and 1.24 (compared to the MRL). Values for other chemicals were substantially lower, from about one percent of the benchmark to six or seven orders of magnitude below levels of concern. See Table 4-5 for a summary of the acute effects assessment.

As indicated above, the index for acute hazards estimated for non-criteria pollutants in this study slightly exceeds one of the two benchmarks employed in this study for comparison; it is slightly lower than the other. In both cases, however, the quotients exceed the value of 0.5 generally favored by regulatory agencies as an action level. Therefore, at this point in time, we cannot assure that emissions from Outboard Marine/Bombardier will not lead unacceptably to adverse health effects at the proposed sports complex. Before a final determination is made concerning such emissions, it is strongly recommended that emission estimates from these facilities be reevaluated. If the emission estimates are confirmed to be accurate, then a more sophisticated (Level III) analysis should be performed to determine whether emissions from these two facilities may in fact contribute unacceptably to acute hazards at the proposed sports complex.

<u>Non-Cancer Hazards</u>

Chronic non-cancer risks to children are estimated to be well below levels of concern (hazard index of 0.5), with a total hazard index of 0.098 (sum of all chemicals and facilities). The highest hazard indices were 0.064 for Outboard Marine Corp./Bombardier (mostly from acrolein and chromium emissions) and 0.030 from Dexter Corporation (mostly diisocyanate emissions). The remaining 15 facilities for which non-cancer hazards could be assessed were three to eight orders of magnitude below levels of concern. The highest hazard quotients from individual chemicals included: diisocyanates (0.029), chromium (0.032) and acrolein (0.024).

Table 4-5: Summary of Acute Risk Findings

	Facility Name	Acute Hazard Ratios* Stack/ REL	Stack/ MRL	Fugitive/ REL	Fugitive/ MRL
1	Outboard Marine Corp.	0.827061	1.282585	N/A	N/A
2	Midwest Generation	0.014432	N/A	N/A	N/A
3	Dexter Corporation	0.009953	0.000278	0.009788	0.000347
4	Roqette America, Inc.	0.004727	N/A	9.6E-05	N/A
5	Abbott Labs	0.001734	0.000787	1.46E-06	N/A
6	Coral Chemical Company	0.000617	N/A	0.000617	N/A
7	R. Lavin & Sons, Inc.	0.000302	N/A	0.000205	N/A
8	Stone Container	0.000264	8.34E-05	N/A	N/A
9	Gillette Co.	7.15E-05	4.49E-05	7.53E-07	4.16E-06
10	Domino Amjet Inc.	3.4E-05	N/A	N/A	N/A
11	Emco Chemicals	2.78E-05	2.37E-05	3.88E-05	1.64E-05
12	Pfanstiehl Laboratories Inc.	2.76E-05	7.5E-07	N/A	N/A
13	Gallagher Corporation	1E-05	4.33E-05	N/A	N/A
14	BASF/ PPG Industries	1.57E-06	N/A	4.82E-06	N/A
15	Avery-Dennison Commerical Products	1.4E-06	1.88E-06	N/A	N/A
16	Cherry Electrical Products	N/A	N/A	7.78E-05	0.000191
17	Cosmed of Illinois	N/A	N/A	N/A	N/A
18	Fansteel, Inc. (Federal Die Casting Co.)	N/A	N/A	N/A	N/A
19	Provena Hospitals D/B/A St. Therese Med. Ctr.	N/A	N/A	N/A	N/A
20	Victory Memorial Hospital	N/A	N/A	N/A	N/A
	Totals:	0.859263	1.283848	0.01083	0.000558

* Stack = 1-hour Maximum Stack Concentration
Fugitive = 1-hour Maximum Fugitive Concentration
REL = OEHHA Acute REL
MRL = ATSDR Acute MRL

NA - designates that an acute effects assessment could not be completed because either (1) acute toxicity criteria (MRLs or RELs) were not available for those chemicals emitted by the facility and/or (2) the facility did not have that type of emission (stack or fugitive). See Appendix C for more information on the chemicals emitted by each facility.

Values for other chemicals were very low, as small as nine orders of magnitude below levels of concern (hazard quotient of 0.5). Thus, none of the chemicals emitted from sources within 5-miles of the proposed sports complex appears to pose an unacceptable risk for chronic non-cancer effects. See Table 4-6 for summaries of the non-cancer hazard findings.

Cancer Risks

Predicted cancer risks for children are below levels of concern, with a total cancer risk (sum of all 12 facilities that emit carcinogenic chemicals) of 5.72E-07. The highest risks came from Outboard Marine Corp./Bombardier (5.31E-07), Cosmed of Illinois (1.55E-08), and Midwest Generation (1.49E-08). The remaining nine facilities emitting carcinogens had cancer risks in the 1.0E-09 to 1.0E-12 range. The chemicals providing most of the cancer risks were chromium (4.42E-07), 1,3-butadiene (8.90E-08), ethylene oxide (2.17E-08), and formaldehyde (1.28E-08). The remaining eleven carcinogenic chemicals had cancer risks in the 1.0E-09 to 1.0E-13 range. Thus, none of the chemicals emitted from sources within 5-miles pose an unacceptable cancer risk to users of the proposed sports complex. See Table 4-7 for summaries of the cancer risk findings.

Table 4-6: Summary of Non-Cancer Hazard Findings

	Facility Name	Child Total Hazard
1	Outboard Marine Corp.	0.0644688
2	Dexter Corporation	0.0301247
3	Midwest Generation	0.0018974
4	Fansteel, Inc. (Federal Die Casting Co.)	0.0006072
5	Abbott Labs	0.0002939
6	R. Lavin & Sons, Inc.	4.596E-05
7	Cherry Electrical Products	2.553E-05
8	Gillette Co.	1.763E-05
9	Coral Chemical Company	1.466E-05
10	Emco Chemicals	6.951E-06
11	Pfanstiehl Laboratories Inc.	5.766E-06
12	Stone Container	4.138E-06
13	BASF/ PPG Industries	3.803E-06
14	Gallagher Corporation	2.939E-06
15	Domino Amjet Inc.	1.633E-06
16	Roqette America, Inc.	1.466E-06
17	Avery-Dennison Commerical Products	2.317E-08
18	Cosmed of Illinois	N/A
19	Provena Hospitals D/B/A St. Therese Med. Ctr.	N/A
20	Victory Memorial Hospital	N/A
		0.0975225

NA - designates that non-cancer effects wer not evaluated because of toxicity criteria (RfCs or RfDs) were not available for those chemicals emitted by the facility. See Table 4-4 and section 4.2.4 of the report for discussion of those chemicals for which toxicity criteria were not available for non-cancer effects. It should be noted that some of these chemicals may have been tested and found not to have such non-cancer effects.

Table 4-7: Summary of Cancer Risk Findings

	Facility Name	Child Total Risk
1	Outboard Marine Corp.	5.311E-07
2	Cosmed of Illinois	1.545E-08
3	Midwest Generation	1.488E-08
4	BASF/ PPG Industries	4.976E-09
5	Abbott Labs	1.966E-09
6	Dexter Corporation	1.953E-09
7	Provena Hospitals D/B/A St. Therese Med. Ctr.	1.266E-09
8	Gallagher Corporation	1.955E-10
9	Emco Chemicals	8.547E-11
10	Stone Container	2.81E-11
11	Avery-Dennison Commerical Products	4.667E-12
12	Victory Memorial Hospital	2.352E-12
13	Cherry Electrical Products	N/A
14	Coral Chemical Company	N/A
15	Domino Amjet Inc.	N/A
16	Fansteel, Inc. (Federal Die Casting Co.)	N/A
17	Gillette Co.	N/A
18	Pfanstiehl Laboratories Inc.	N/A
19	R. Lavin & Sons, Inc.	N/A
20	Roqette America, Inc.	N/A
		5.72E-07

N/A - designates that cancer risks were not evaluated because toxicity criteria (unit risks or cancer slope factors) were not available for those chemicals emitted by the facility. See Table 4-4 and section 4.2.4 of the report for discussion of those chemicals for which carcinogenic toxicity criteria were not available. It should be noted that some of these chemicals may have been tested and found not to have carcinogenic effects.

5. ASBESTOS ANALYSIS

Asbestos was identified as a concern in this study because the landfill on the adjacent NPL site is known to contain asbestos and asbestos-containing debris. Asbestos-containing debris is also known to have been used as base for unpaved roads and the construction of dikes and berms on the adjacent NPL site and the Illinois Beach State Park and Nature Preserve (north of the site). Such debris may also have been used elsewhere (See Chapter 3). Furthermore, asbestos-containing debris has been observed along the Lake Michigan waterfront in areas extending from the beaches in the Illinois Beach State Park and Nature Preserve (to the north), continuing along the beach east of the JM Disposal Area NPL site, to the beach and levee of the Midwest Generation Station (immediately south of the property).

Consequently, a field investigation was conducted to identify surface features and near surface features in the vicinity of the site that contain asbestos and to establish a rough indication of the nature and concentrations of asbestos identified in such features. Results from this evaluation were then combined with appropriate emission and dispersion models to provide estimates of airborne asbestos concentrations that might develop at the location of the proposed sports complex due to releases from the various asbestos-containing features investigated at these offsite locations. Evaluation of potential airborne concentrations of asbestos derived from onsite sources will be addressed in the upcoming, Stage 2 report.

Estimated asbestos concentrations from measurement and modeling were then compared with acceptable exposure concentrations (derived from published and pending dose-response models for asbestos) to assess potential health consequences for users who might visit the proposed sports complex. Conclusions from this assessment were used to derive recommendations for actions that would be required to assure that future visitors to the proposed sports complex were not placed at undue risk from exposure to asbestos from offsite sources. Results of the field investigation, the emission and dispersion modeling to assess exposure, the evaluation of the attendant health effects, and our conclusions and recommendations are presented in the remaining sections of this chapter.

5.1 Field Investigation

As previously indicated, the field investigation conducted to support evaluation of the effects of sources of asbestos in the vicinity of the proposed sports complex was designed to identify surface and near-surface features that contain asbestos and to provide a general indication of the types and concentrations of asbestos that may be present in such features. It was not intended to provide a detailed characterization of the distribution of asbestos concentrations in the various matrices in which asbestos was identified.

> Note that, to bring closure to lead-related issues at the site, samples collected for asbestos determination were also analyzed for lead. Results of the evaluation of lead are discussed in Section 5.5.

Given the stated objectives, the investigation incorporated collection of large (kg size) samples from each of multiple locations within each matrix of interest that were then composited, homogenized, and split in the field to generate 100 g size sub-samples of each composite for analysis in the selected laboratory. Sample locations were typically arranged in a systematic array designed to generate a representative sample of a large pre-selected volume of the matrix of interest. Compositing was performed to cost-effectively obtain estimates of mean concentrations with a minimal number of analyses.

Procedures used in this investigation for sample collection and field compositing, homogenization, sub-sampling, and appurtenant operations are described in Chapter 8 of Berman and Kolk (1997), which has been adopted by EPA as an interim Superfund Method. Samples were analyzed for asbestos using the modified elutriator method

(Berman and Kolk 2000), which is a refined version of the interim method. Lead analyses were performed using Methods 7420 and 3050 (USEPA SW-846).

Asbestos Investigation

The modified elutriator method provides asbestos concentrations reported as the number of asbestos structures (of the size-range of interest) per unit mass of the respirable dust (i.e. s/g_{PM10}) that is simultaneously released from the sample during analysis for asbestos. A dimensional analysis has shown that measurements reported in such a manner are precisely what is required as inputs to published dust emission models to convert them to asbestos emission models (Berman and Kolk 1997). Such measurements can thus be combined with appropriate emission and dispersion models to predict airborne exposure concentrations and their associated risk. Moreover, a recently published study (Berman 2000) demonstrates that combining measurements derived using the modified elutriator method with properly selected emission and dispersion models allows prediction of airborne exposure concentrations with reasonably good accuracy that is adequate for supporting risk assessment.

The manner in which asbestos structures were characterized during analysis and the range of structure sizes and shapes that were included in the determination of asbestos concentrations was selected to support risk assessment performed as prescribed in a new protocol for assessing asbestos-related risks (Berman and Crump 1999a). Based on a critical review of the literature and supplemented with additional studies (as reported in the technical support document to the protocol: Berman and Crump 1999b), a new exposure index for asbestos is recommended in the protocol, which better captures the size range of asbestos structures that contribute to risk than the asbestos exposure index that has been used traditionally. The range of sizes for asbestos structures included in this new index are those longer than 5 µm and thinner than 0.5 µm with contributions to overall potency of structures longer than 10 µm weighted more heavily. Structures that satisfy these dimensional requirements have come to be called, "protocol structures."

Results from sampling and analysis of offsite matrices of concern are presented in Table 5-1. A small number of areas located directly on the former JM manufacturing facility were also sampled to better evaluate the full range of concentrations expected to be encountered in asbestos-containing debris in the area. The onsite areas selected for sampling were areas where the highest concentrations of asbestos-containing debris had previously been observed (JM staff, personal communication, based on a map indicating observation of asbestos-containing debris). Results from the analysis of onsite samples are presented in Table 5-2.

Table 5-1 indicates the set of offsite matrices sampled for asbestos and the results from the analysis of such samples. The table is organized as follows:

- the first column provides the Sample Identification Number for each composite analyzed;
- Column 2 is a brief description of each matrix sampled;
- Column 3 indicates the results of the silt content analysis performed on each composite sample;
- Column 4 presents results of analysis by polarized light microscopy (PLM) for the subset of samples analyzed using this method;
- Column 5 presents the concentration of asbestos protocol structures per gram of respirable dust in each sample;
- Column 6 indicates the number of protocol structures counted;
- Column 7 indicates the fraction of protocol structures longer than 10 µm;

TABLE 5-1
BULK ASBESTOS SAMPLING RESULTS FROM OFFSITE LOCATIONS NEAR THE PROPOSED SPORTS COMPLEX

"OFFSITE" SAMPLES

Sample Identifier	Description	Results: Adj. Silt Content (% mass)	PLM (area %)	Superfund Method: Str Conc (s/gPM10)	No. prot Strctrs	% Long Strctrs	Mineral Type	Duplicate RPD	Analytical Sensitivity (s/gPM10)
1S	Swale	6.54	<1%, chrys	1.4E+09	77	49	chrys	17%	1.8E+07
				7.4E+07	4	75	crc	40%	
1S1	duplicate split		<1%, chrys	1.2E+09	65	40	chrys	--	1.8E+07
				1.1E+08	6	17	crc	--	
1CE	Midwest Generation Property	24.92	<1%, chrys+ams	1.3E+07	6	33	chrys		2.2E+06
1CE1	duplicate split		<1%, chrys						
1RS	Road on DNR prop - Shallow	6.19	<1%, chrys+crc	3.2E+07	5	20	chrys		6.4E+06
				2.0E+08	31	61	crc		
1RS1	duplicate split		<1%, crc+chrys						
1RD	Road on DNR prop - deep	5.22	ND	5.0E+08	28	50	chrys	116%	1.8E+07
				2.0E+09	110	57	crc	82%	
1RD1	duplicate split		1-2%, chrys+crc	1.9E+09	93	55	chrys	--	2.0E+07
				8.3E+08	41	54	crc	--	
1B	DNR beach sample	1.98	ND	6.4E+06	1	100	chrys		6.4E+06
				8.3E+07	13	39	crc		
1B1	duplicate split		ND						
1D	berm to east of NPL landfill	47.92		ND	0	0	None		3.0E+06
1D1	duplicate split								
2D	berm north of ind canal by DNR	4.49		4.2E+06	1	100	chrys		4.2E+06
				3.8E+07	9	66	crc		
2D1	duplicate split								
3D	berm btwn ind canal and NPL landfill	52.49		ND	0	0	None		2.5E+06
3D1	duplicate split								
1L	NPL landfill cap west of settling basin	48.70		ND	0	0	None		1.9E+06
1L1	duplicate split								
4RS	Road east of borrow pit - shallow	11.00		ND	0	0	None		2.4E+06
4RS1	duplicate split								
4RD	Road east of borrow pit - deep	6.00		3.4E+08	23	70	chrys		1.5E+07
				2.3E+08	16	63	crc		
4RD1	duplicate split								
2RS	Road in SE corner of prop - shallow	16.03		ND	0	0	None		2.2E+06
2RS1	duplicate split								
2RD	Road in SE corner of prop - deep	11.10		1.7E+08	28	46	chrys		6.0E+06
				7.2E+07	12	58	crc		
				1.8E+07	3	33	ams		
2RD1	duplicate split								
3RS	Road SE corner of settling basin - shallow	10.99		2.3E+06	1	0	chrys		2.3E+06
				4.5E+06	2	0	crc		
3RS1	duplicate split								
3RD	Road SE corner of settling basin - deep	6.60		1.5E+07	6	83	chrys		2.5E+06
				3.2E+07	13	39	crc		
3RD1	duplicate split								
2L	NPL landfill cap S of settling basin	46.07		ND	0	0	None		2.3E+06
2L1	duplicate split								
2B	JM/NPL property Beach Sample	0.00		5.1E+06	1	100	trem		5.1E+06
2B1	duplicate split								
5RS	Greenwood Ave W from pwr plnt - shallow	19.44		5.7E+08	58	40	chrys		9.9E+06
				2.0E+07	2	50	crc		
				5.0E+07	5	60	ams		
5RS1	duplicate split								
5RD	Greenwood Ave W from pwr plnt - deep	16.42		1.1E+09	71	38	chrys		1.5E+07
				7.7E+07	5	0	crc		
				1.5E+08	10	30	ams		
5RD1	duplicate split								

Table 5-1 (cont.)

Sample Identifier	Description	Results Adj. Silt Content (% mass)	PLM (area %)	Superfund Method Str Conc (s/gPM10)	No. prot Strctrs	% Long Strctrs	Mineral Type	Duplicate RPD	Analytical Sensitivity
LOSP	Lower Sand Pile on Midwest Gen Prop	2.5		1.9E+07	7	100	chrys		2.7E+06
LESP	Lower Sand Pile on Midwest Gen Prop	2.3							
UOSP	Upper Sand Pile on Midwest Gen Prop	1.3		3.0E+07	11	82	chrys	28%	2.7E+06
				4.1E+07	15	80	amph	88%	
UESP	Upper Sand Pile on Midwest Gen Prop	1.9		2.3E+07	10	70	chrys	--	2.3E+06
				1.6E+07	7	66	amph	--	
Blank	Washed sand blank	NA	NA	ND	0	0	None		see ftnte

Note: ND = None detected. NA = Not Analyzed or Not Applicable
Types of asbestos: Chrys = chrysotile, Crc = crocidolite, Ams = Amosite, Trem = tremolite
Based on time collected, the analytical sensitivity for the blank would be less than a quarter of that for the true samples.
Based on dust collected, the analytical sensitivity for the blank is calculated to be 2.97E+7

Note that the duplicate samples from the sand pile are "duplicate composites" not duplicate splits.
Such samples also incorporate spatial variation in the field.

TABLE 5-2:
BULK ASBESTOS SAMPLING RESULTS FROM ONSITE LOCATIONS AT THE PROPOSED SPORTS COMPLEX

ONSITE SAMPLES

Sample Identifier	Description	Results: Adj. Silt Content (% mass)	PLM (area %)	Superfund Method: Str Conc (s/gPM10)	No. prot Strctrs	% Long Strctrs	Mineral Type	Duplicate RPD	Analytical Sensitivity (s/gPM10)
Sample A	Flat area west of Pumping Lagoon	13.90	Chrys 10%, Crc 2%	8.9E+08	56	32%	Chrys		1.6E+07
				1.3E+08	8	63%	Crc		
Sample B	Area South of Pumping Lagoon	15.16	Chrys 6%, Crc <1%	3.9E+08	39	41%	Chrys		1.0E+07
				9.0E+07	9	78%	Crc		
Sample C	East of main JM building	12.72	Chrys 2%, Ams 1%	1.4E+08	43	44%	Chrys		3.4E+06
				4.7E+07	14	36%	Ams		
Sample D	Near Old Zerolite bulding	11.94	Chrys 4%, Crc 3%	6.1E+08	46	35%	Chrys		1.3E+07
				4.0E+07	3	33%	Crc		
				1.3E+07	1	100%	Ams		
Blank	Washed sand blank (from Offsite set)	NA	NA	ND	0	0%	None		see ftnte

Note: ND = None detected. NA = Not Analyzed or Not Applicable
Types of asbestos: Chrys = chrysotile, Crc = crocidolite, Ams = Amosite
Based on time collected, the analytical sensitivity for the blank would be less than a quarter of that for the true samples.
Based on dust collected, the analytical sensitivity for the blank is calculated to be 2.97E+7

- Column 8 indicates the mineral type(s) of asbestos encountered in each sample;

- Column 9 presents the relative percent difference (RPD) for the duplicate pairs analyzed in this investigation. The relative percent difference is an indication of the degree of agreement (precision) between duplicate measurements; and

- Column 10 indicates the analytical sensitivity (i.e. the concentration equivalent to the detection of a single asbestos structure) achieved for each of the analyses performed.

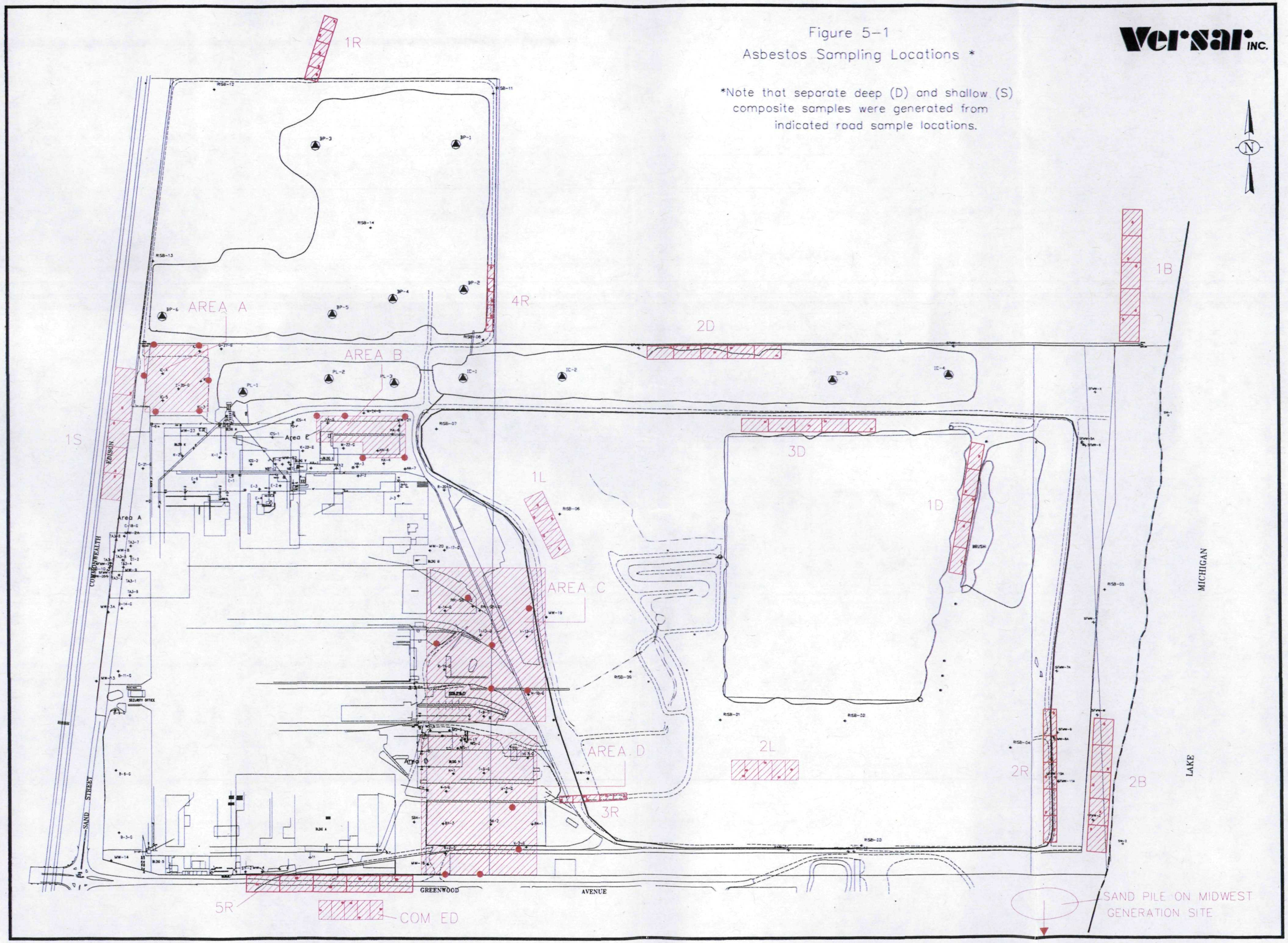
Table 5-2 is arranged in the same format. Note that the data presented in Columns 5 through 10 in these tables are all derived based on the analysis of samples by the modified elutriator method (Berman and Kolk 2000). Note further that this method incorporates analysis of asbestos by transmission electron microscopy (TEM), which has been shown capable of detecting asbestos structures over the entire range of sizes relevant for risk assessment (Berman and Crump 1999b).

The locations from which the individual field samples were collected for each composite representing each of the offsite matrices sampled as reported in Table 5-1 are depicted in Figure 5-1. Thus, for example, the sediment in the swale that runs approximately south to north along the western edge of the proposed sports complex site was sampled at five locations defined by a grid on 100 ft centers running parallel to the center line of the swale and a width equal to the width of the flat bottom of the swale. One sample was collected from a randomized location from within each grid rectangle. Samples were collected for compositing using a similar scheme for the locations "onsite" of the proposed sports complex and the onsite locations sampled are also depicted in Figure 5-1.

Several observations concerning the data presented in Tables 5-1 and 5-2 are worth noting. First, both chrysotile and amphibole asbestos (primarily crocidolite with some

Figure 5-1
Asbestos Sampling Locations *

*Note that separate deep (D) and shallow (S) composite samples were generated from indicated road sample locations.



amosite) are observed in the majority of samples analyzed. Furthermore, particularly for samples collected in the borrow area and the disposal area NPL site of the former JM manufacturing facility property, crocidolite and chrysotile are found at similar concentrations. This is important because evidence indicates that (for similarly sized fibers) amphibole asbestos types are substantially more hazardous than chrysotile (Berman and Crump 1999a and b).

Second, with one potential exception, it appears that the material used for capping on the disposal area NPL site is indeed asbestos-free, as intended. Thus, for example, the composite samples for the berm to the east of the NPL landfill (1D), the berm between the industrial canal and the NPL landfill (3D), the NPL landfill cap west of the Figure 5-1 settling basin (1L), the NPL cap south of the settling basin (2L), and the shallow material in the road in the southeast corner of the NPL property (2R) are all non-detect for asbestos.

Note that the composite collected from the "berm" north of the industrial canal (between the disposal area NPL site and the Illinois Beach State Park and Nature Preserve), which is Sample No. 2D, exhibits detectable concentrations of asbestos (primarily crocidolite). However, it has been reported that this "berm" has never been capped (JM staff, personal communication). The term "berm" is used loosely for this area because, while the soil matrix in this area forms the northern boundary of the industrial canal, it may be largely natural material (i.e. never constructed formally as a berm).

The one potential exception to the trend showing no asbestos in NPL site capping material is the shallow sample from the road that runs from the manufacturing area of the former JM facility into the disposal NPL site area (southwest of the settling basin). The composite sample from the shallow material in this road exhibited three asbestos fibers (one chrysotile and two crocidolite), which suggests low, positive concentrations of asbestos (on the order of 2 to 4 x 10^6 s/g_{PM10}). However, it is not clear that this road was ever capped (Illinois Department of Natural Resources staff, personal communication).

The trend in asbestos concentrations observed among the composites collected on the various unpaved roads is also instructive. Roads were each sampled at two depths. Individual sample locations defined by the grid for each road (Figure 5-1) were each sampled within the top 3 inches of the surface of the road and at a greater depth constituting the top 6 inches of the underlying base material. Samples from each depth stratum were then composited to produce one shallow and one deep composite, respectively.

Five roads were sampled in all: the abandoned road in the Illinois Beach State Park and Nature Preserve (running north from the borrow area on the former JM site), a road on the eastern edge of the borrow area itself, a road running north-south near the eastern edge of the NPL site (just west of the NPL site beach), a road running southwest-northeast onto southwest corner of the NPL site from the site of the proposed sports complex, and the unpaved shoulder of Greenwood Ave., which runs along the southern border of the former JM manufacturing site. The shallow composites from these roads are represented in Table 5-1 by Sample Nos. 1RS, 4RS, 2RS, 3RS, and 5RS, respectively. The deep composites are: 1RD, 4RD, 2RD, 3RD, and 5RD, respectively.

Excluding Greenwood Ave., the four remaining roads all exhibit substantial concentrations of asbestos (a mix of chrysotile and crocidolite) in the deeper stratum with concentrations ranging up to 2×10^9 s/g_{PM10} for each asbestos type, which are the highest concentrations detected during this investigation. Shallow samples for all roads exhibit substantially lower concentrations with the shallow samples from two of the roads (4RS and 2RS) showing no detectable asbestos.

The samples from Greenwood Ave. exhibit similarly elevated asbestos concentrations, although the mix of the asbestos types is distinctly different for this road than for the other roads. Greenwood Ave. material contains primarily chrysotile with concentrations of amphibole asbestos (a mix of crocidolite and amosite) constituting no more than about 15% of total asbestos.

Based on the data presented in Table 5-2, asbestos concentrations measured in onsite composite samples are among the highest observed during the investigation with both chrysotile and amphibole asbestos being detected. These concentrations are comparable to those found in the deep road samples, described above. At two of the four onsite locations sampled (Sample Nos. A and B), the only amphibole asbestos detected was crocidolite. At the two other locations (Sample Nos. C and D), amosite was also detected.

Regarding quality control, both an evaluation of the results from the duplicate sample pairs analyzed and a comparison of results for the subset of samples analyzed both by PLM and by the modified elutriator method is instructive. Each of the three duplicate pairs analyzed contain both chrysotile and crocidolite so that separate RPD's (Relative Percent Differences) could be calculated for each fiber type. As indicated in Column 9 of Table 5-1, five of the six resulting RPD's are less than 100% and three of the six are less than 50%, which is nominal performance for this method. Thus, results from duplicate analysis of paired samples can be expected to vary by no more than approximately a factor of three and in most cases will vary by no more than a factor of two.

Note that one of the duplicate pairs listed in Table 5-1 (i.e. the pair representing the sand pile) is actually a pair of duplicate composites rather than a true pair of duplicate splits (i.e. paired splits of a single homogenized sample). Duplicate composites are a pair of composite samples that are each derived from an independent set of samples collected from superimposed grids within the same matrix volume. Therefore, such duplicates include spatial variation (in addition to sample and analytical variation) so that they are expected show somewhat poorer agreement (larger RPD's) than true duplicate pairs. Nevertheless, the RPD's observed for this duplicate sample set still show good agreement across the two samples.

Comparing PLM and modified elutriator results for the limited number of offsite samples analyzed by both methods (Table 5-1) indicates no correlation between the two methods. For example, concentrations observed for specific mineral types among these samples vary by more than two orders of magnitude by the modified elutriator method but are all generally reported as "trace" (< 1%) by PLM. Moreover, samples indicated to be non-detect by PLM exhibit among the highest concentrations when measured by the modified elutriator method.

For onsite samples, results of PLM and modified elutriator method measurements reported in Table 5-2 show some correlation (i.e. concentration trends are roughly comparable and roughly vary over the same magnitude in range) for chrysotile, but not for amphiboles. However, comparing these results with those presented in Table 5-1 suggests additional conflicts. For comparable concentrations of specific asbestos types measured by the modified elutriator method, PLM results vary by more than an order of magnitude. Thus, once again, a lack of overall correlation is indicated.

That the problems contributing to the lack of correlation across analytical methods lie primarily (if not exclusively) with PLM (as opposed to the modified elutriator method) is apparent both from an understanding of the relative strengths and limitations of each method and from the quality control data presented in Table 5-1. It is well known, for example, that respirable fibers are generally too thin to be visible by PLM so that measurements by PLM involve a population of structures that are entirely different than those important for risk. Moreover, a recent study shows that there is no reliable method for relating PLM measurements to risk (Berman 2000). In contrast, measurements derived using the modified elutriator method are specifically designed to focus on the asbestos fibers that contribute to risk and measurements derived using this method are designed to support reasonable prediction of exposure and risk (see above).

Regarding RPD;s, as can be seen in Table 5-1, while the RPD's for the duplicate pairs reported are all reasonable for modified elutriator method measurements, the same cannot be said for PLM measurements. For example, PLM measurements for the duplicate sample pair (Sample Nos. 1RD and 1RD1) show both the lowest value (non-detect) and highest value (1 to 2%) determined by PLM for any of the offsite samples. Note, RPD's cannot easily be determined for duplicate PLM measurements because results obtained using this method are only semi-quantitative. Therefore, given the above, PLM measurements are not further addressed in this study.

5.2 Exposure Characterization

Based on the results of sampling and analysis described above, several potential sources of asbestos were identified in the area around the proposed sports complex. Thus, the potential for release of asbestos from these sources and the consequent airborne concentrations that might be produced at the proposed sports complex (following dispersion by the wind) were assessed.

Given the nature of the asbestos sources identified (see below), the primary mechanisms by which asbestos might be released from such sources include direct wind entrainment (mobilization and dispersion) of asbestos from surface material and entrainment following release from surface material due to disturbance by vehicular traffic. Release due to disturbance by excavation was not considered for any of the sources identified in this study. This is because, except for Greenwood Ave., the swale, and sources on the Midwest Generation property, all of the other sources identified are located either in a nature preserve or on an NPL site where excavation would be curtailed. Furthermore, although excavation of swale sediments, Greenwood Ave. material, or the sand pile or vacant yards of the Midwest Generation site might conceivably be excavated at some point in the future, it is expected that such excavation would be associated with projects of very limited duration that would be unlikely to contribute to long-term average exposure. In addition, should concerns be raised for any such projects, the Waukegan Park District retains the option to close any future sports complex while such projects are completed.

Published emission and dispersion models for dust that are appropriate for wind entrainment and vehicular traffic were selected from the literature and modified in the manner described in Berman (2000) so that they could be employed to evaluate asbestos release and transport from sources of interest to the proposed sports complex site. Two emission models were used to evaluate wind entrainment: a model for surfaces with unlimited erosion potential and a model for surfaces with limited erosion potential (Cowherd et al. 1985).

Surfaces with unlimited erosion potential are those that are permanently loose and granular (such as the surface of a sand pile). The dust emissions model for wind entrainment from a surface with unlimited erosion potential (Cowherd et al. 1985) is:

$$E'_{PM10} = 0.036(1-V)\left(\frac{[U]}{U_t}\right)^3 F_{(x)} \qquad (5.1)$$

where:

- E'_{PM10} is the emission factor (g/m^2-hr);
- V is the fraction of surface covered by continuous vegetation;
- $[U]$ is the mean annual wind speed (m/s);
- U_t is the threshold value of wind speed for emissions adjusted to a height of 7m (m/s); and
- $F_{(x)}$ is a special function indicating the relationship between emissions and wind, which is defined in Cowherd et al. (1985) (unitless).

To convert this model to an asbestos emission model, the terms on the right side of the equation were multiplied by two factors: $R_{a/d}$ and A_d, which represent, respectively, the concentration of asbestos in the surface material (s/g_{PM10}) and the total area from which emissions occur (m^2). The model was further modified by adding a dispersion term so that airborne concentrations could be predicted for fixed distances downwind of the source being modeled.

The final, adjusted/combined model used for predicting downwind airborne asbestos concentrations following wind entrainment from a source exhibiting an unlimited erosion potential is:

$$C'_{asb} = \left(\frac{0.036 Q_1 Q_2 R_{a/d} (1-V) \left(\frac{[U]}{U_t} \right)^3 F_{(x)}}{(2 \pi \sigma_z \sigma_y [U])} \right) \qquad (5.2)$$

where:

- C'_{asb} is the airborne concentration of asbestos at a fixed distance "x" downwind of the source (s/cm^3);
- Q_1 is a constant equal to 1/3600 to convert emissions per hour to emissions per second;
- Q_2 is a constant equal to 1×10^{-6} to convert concentrations from s/m^3 to s/cm^3;
- $R_{a/d}$ is the concentration of asbestos in the material from which emissions occur (s/g_{PM10});
- π is the constant "pi" equal to 3.1415...;
- σ_z is the vertical dispersion coefficient (m), as defined in Turner (1970);
- σ_y is the lateral dispersion coefficient (m), as defined in Turner (1970); and

all other parameters have been previously defined.

Surfaces with limited erosion potential are those that tend to cake or form crusts (such as clayey or silty soils). Once a crust forms, a finite pool of erodible material typically remains above the crust so that, once this material is depleted, further erosion is prevented until some type of mechanical force disturbs the surface and the pool of erodible material is renewed.

The dust emissions model for wind entrainment from a surface with limited erosion potential (Cowherd et al. 1985) is:

$$E_{PM10} = (0.001 * 0.83)\left(\frac{f * P_{(U^+)} * (1-V)}{\left(\frac{PE}{50}\right)^2}\right) \tag{5.3}$$

where:

E_{PM10} is the emission factor (g/m^2-hr);

f is the frequency of disturbance of the surface (number/month);

$P_{(U+)}$ is the erosion potential (g/m^2). The erosion potential is a function of the mean daily fastest mile of wind, "U^+";

V is the fraction of surface covered by continuous vegetation; and

PE is the Thornswaite precipitation/evaporation index (unitless).

This model was also modified in a manner entirely analogous to that described above to yield the following model for predicting asbestos concentrations at fixed distances downwind of a source of interest:

$$C_{asb} = (8.3x10^{-4})Q_1Q_2R_{A/D}\left(\frac{f * P_{(U^+)} * (1-V)}{\left(\frac{PE}{50}\right)^2}\right)\left(\frac{1}{2\pi\sigma_z\sigma_y[U]}\right) \tag{5.4}$$

where all terms have been previously defined.

The underlying dust model employed to evaluate emissions due to vehicular traffic is the Copeland model (U.S. EPA 1985) and this model was modified in two ways: one to estimate short-term "peak" exposures (which would occur over intervals of time when multiple vehicles may be simultaneously traversing the surface of interest) and one to estimate long-term "average" exposures (in which the emissions attributable to vehicles traversing the surface are averaged over long periods of time that also include periods when no vehicles are traversing the surface). Both versions of the Copland model were further modified in a manner entirely analogous to that described above for the wind entrainment models (and described in greater detail in Berman, 2000) to convert them to models for estimating downwind asbestos concentrations attributable to the emissions of interest.

The resulting model for estimating peak exposure is:

$$C_{Apk} = \left[\frac{(4.42x10^{-11})R_{a/d}N_{inst}(s)(S^{2})(W)^{0.7}(w)^{0.5}}{(M)^{0.3}}\right]\left(\frac{1}{2\pi\sigma_z\sigma_y[U]}\right)\left[T_f+(1-T_f)(V_f)\right] \tag{5.5}$$

where:

C_{Apk}	is the peak concentration of asbestos at a fixed distance "x" downwind of the source of interest (s/cm^3);
N_{inst}	is the number of vehicles traversing the surface at any one time (number);
s	is the silt content of the surface (wt %);
S	is the mean vehicle speed (km/hr);
W	is the mean vehicle weight (Mg);
w	is the mean number of wheels (number);
M	is the moisture content (wt %);

T_f is the fraction of time that vehicles traverse bare ground (as opposed to vegetated or otherwise covered ground) (dimensionless);

V_f is the emission reduction factor for activities on vegetated (vs. bare) ground (dimensionless); and

all other parameters have been previously defined. Also, the equation has been simplified to combine all constants and integers.

The model employed for estimating average exposures attributable to vehicular traffic on unpaved surfaces is:

$$C_{Aavgd} = \left[\frac{(4.42x10^{-11})R_{a/d}N_{pd}K(s)(S)(W)^{0.7}(w)^{0.5}}{(M)^{0.3}}\right]\left(\frac{1}{2\pi\sigma_z\sigma_y[U]}\right)[T_f+(1-T_f)(V_f)] \tag{5.6}$$

where:

C_{Aavgd} is the average concentration of asbestos at a fixed distance "x" downwind of the source of interest (s/cm^3);

N_{pd} is the number of vehicles traversing the surface per day (number);

K is the total mean length of each traverse (km); and

all other parameters have been previously defined.

Note that some sources exhibit a cross sectional width (the width perpendicular to the direction of the sports complex) that is large relative to the distance to the sports complex. Therefore, the dispersion portions of the above model had to be modified so that such sources were treated as virtual point sources. This is a simple adjustment in which:

- the distance from a virtual point source for which the transverse dispersion coefficient (σ_y) becomes equal to the actual transverse width of the source of interest is determined from tables in Turner (1970);

- the calculated distance to the virtual point source (derived as described above) is added to the distance between the "actual" source and the proposed sports complex to determine a new total distance between the "virtual" source and the proposed sports complex; and

- the actual source is then modeled as a virtual source using the above equations. This means that the new calculated distance between the "virtual" source and the sports complex is substituted into the calculations used to estimate the appropriate dispersion coefficients (rather than the distance between the "actual" source and the sports complex).

Additionally, for sources that are closer to the proposed sports complex site than a few hundred meters, the dispersion portion of the above equations (which incorporate Gaussian dispersion coefficients per the work of Turner 1970) are replaced by a box model in which the dispersion coefficients are replaced by variables representing the cross-wind width (w) and the mixing height (h) of the box. A low value is always chosen for the mixing height of the box, to assure that concentration estimates are conservative in a health protective sense.

The sources evaluated using the above models to estimate asbestos concentrations that may occur at the proposed sports complex due to emissions from each source are described below. Results from the evaluation of emissions are also presented.

The sources of asbestos evaluated in this study and their associated characteristics are listed in Table 5-3. The general areas and specific features that were identified as potential sources are listed in the first column of this table.

TABLE 5-3:
DIMENSIONS AND CHARACTERISTICS OF RELEVANT, POTENTIAL ASBESTOS SOURCES IN THE VICINITY OF THE NEW SPORTS COMPLEX (SC)

Area/Feature	Rep Sample No.	Area	Cross-Wind Width	Closest Distance from SC	Direction to SC	Fraction of Time Winds Aligned	Mean Velocity	Fastest Mile	Fraction Plant Cover	Estimated Bulk Asbestos Content	% Long	Asb. Type	Rate of Monthly Events	Exposure Pathway	Estimated Maximum Airborne Concentration	Estimated Wind-Averaged Airborne Concentration
		(m^2)	(m)	(m)		(%)	(m/s)	(m/s)	(%)	(str/g_{PM10})	(%)		(#/mo)		(str/cm^3)	(str/cm^3)
Illinois Beach State Park and Reserve																
Road	1R	2.0E+03	7	457	S	10%	4.60	21	75.0%	2.50E+09	55.0%	amph	0.2	wind	1.03E-06	1.03E-07
"Whole" beach	1B	4.7E+05	4573	1098	WSW	20%	4.60	21	0.0%	9.00E+07	45.0%	amph	1.0	wind	3.82E-06	7.64E-07
"Near" beach	1B	5.2E+04	500	1098	WSW	10%	4.60	21	0.0%	9.00E+07	45.0%	amph	1.0	wind	3.34E-06	3.34E-07
Rest of property	None	*May not contain asbestos, is largely vegetated and flooded so that emissions should be minimal. Not further considered.*														
The JM Borrow Area																
Roads in borrow pit area	4R	9.4E+03	550	155	S	20%	4.60	21	0.0%	2.00E+08	63.0%	amph	1.0	wind	1.88E-05	3.76E-06 *
												Peak:	NA	vehicular	**1.95E-03**	**3.90E-04** *
												Avg:	10.0	vehicular	1.19E-06	2.38E-07 *
The JM Disposal Area NPL Site																
Northeast berm segment	2D	1.5E+04	400	230	SW	15%	4.60	21	25.0%	4.00E+07	66.0%	amph	1.0	wind	4.41E-06	6.62E-07
North berm segment	2D	2.5E+04	550	110	S	20%	4.60	21	25.0%	4.00E+07	66.0%	amph	1.0	wind	1.07E-05	2.14E-06
NPL Site beach	2B	9.5E+04	775	840	W	15%	4.60	21	0.0%	1.00E+07	Ind	amph	1.0	wind	1.48E-06	2.22E-07
Nearest road on NPL Site	2R,3R	4.5E+03	675	10	W	20%	4.60	21	0.0%	1.00E+08	60.0%	amph	1.0	wind	4.53E-05	9.06E-06
												Peak:	NA	vehicular	**9.79E-03**	**1.96E-03**
												Avg:	10.0	vehicular	2.87E-06	5.74E-07
Roads on rest of NPL Site	2R,3R	3.7E+04	800	430	W	20%	4.60	21	0.0%	1.00E+08	60.0%	amph	1.0	wind	9.94E-06	1.99E-06 *
												Peak:	NA	vehicular	**2.61E-04**	5.22E-05 *
												Avg:	10.0	vehicular	6.30E-07	1.26E-07 *
The rest of the NPL Site	1,2L; 1,3D	*Except for the specific areas listed, samples from the surface of the rest of the NPL site showed no detectable asbestos*														
The Swale	S1	1.6E+04	800	10	E	35%	4.60	21	0.0%	1.00E+08	60.0%	amph	0.2	wind	3.20E-05	1.12E-05
Greenwood Ave																
The road (width=right of way)	5R	2.4E+04	1000	10	N	24%	4.60	21	0.0%	2.50E+08	60.0%	amph	1.0	wind	**4.38E-04**	1.05E-04
												Peak:	NA	vehicular	**1.65E-02**	**3.96E-03**
												Avg:	1500.0	vehicular	**1.12E-03**	**2.69E-04**
The Asbestos Site No. 2	estd	5.7E+04	350	670	WNW	8%	4.60	21	0.0%	2.50E+09	60.0%	amph	1.0	wind	**5.73E-04**	4.58E-05
The Midwest Generation Property																
The property beach	estd	5.0E+04	700	3000	WNW	8%	4.60	21	0.0%	9.00E+07	60.0%	amph	1.0	wind	8.28E-07	6.62E-08
The western lawn	1CE	3.5E+05	500	30	N	24%	4.60	21	50.0%	2.00E+07	30.0%	chrys	5.0	wind	9.37E-04	2.25E-04
The sand pile (main pile)	UOSP	5.6E+03	100	700	NW	20%	4.60	21	0.0%	5.00E+07	80.0%	amph	10.0	wind	1.09E-06	2.18E-07
The sand pile (& surrounding sand)		4.5E+04	375	600	NW	20%	4.60	21	0.0%	5.00E+07	80.0%	amph	10.0	wind	3.85E-06	7.70E-07
The rest of the site	estd	1.0E+06	1000	500	N	24%	4.60	21	50.0%	2.00E+07	30.0%	chrys	5.0	wind	1.01E-04	2.42E-05
The Industrial Canal																
Shore sediment	estd	8.0E+03	300	200	SW	15%	4.60	21	0.0%	2.50E+09	60.0%	amph	0.2	wind	6.47E-05	9.71E-06
Total sediment	estd	7.6E+04	300	200	SW	15%	4.60	21	0.0%	2.50E+09	60.0%	amph	0.2	wind	**6.14E-04**	9.21E-05

Table 5-3 (cont.)

Area/Feature	Rep Sample No.	Area	Cross-Wind Width	Closest Distance from SC	Direction to SC	Fraction of Time Winds Aligned	Mean Velocity	Fastest Mile	Fraction Plant Cover	Estimated Bulk Asbestos Content	% Long	Asb. Type	Rate of Monthly Events	Exposure Pathway	Estimated Maximum Airborne Concentration	Estimated Wind-Averaged Airborne Concentration
		(m^2)	(m)	(m)		(%)	(m/s)	(m/s)	(%)	(str/g_{PM10})	(%)		(#/mo)		(str/cm^3)	(str/cm^3)
The Pumping Lagoon																
Shore sediment	estd	1.8E+03	300	50	S	20%	4.60	21	0.0%	2.50E+09	60.0%	amph	0.2	wind	5.33E-05	1.07E-05
Total sediment	estd	1.8E+04	300	50	S	20%	4.60	21	0.0%	2.50E+09	60.0%	amph	0.2	wind	5.33E-04	1.07E-04

NOTES:

All distances are from the feature indicated to the closest boundary of the proposed sports complex
Lengths and widths of areas estimated from the various maps provided in the figures.
The "near" beach means the stretch of DNR beach extending 500 ft to the north from the JM property line
The northeast berm segment is the raised dry area between the Industrial Canal and the DNR fence line
The north berm segment is the raised, dry area between the pumping lagoon and the borrow pit area
This is the total length and area of all roads in the borrow pit area and the distance to the proposed sports complex is based on the closest road segment
This is the total length and area of all roads on the NPL site and the distance to the proposed sports complex is based on the average distance of all roads
This is the length and area of the road segment on the NPL property that is nearest to the proposed sports complex
Shore sediments are the outer 10% of the sediments that would be uncovered if the water level dropped sufficiently to expose 10% of the bottom of the canal
Shore sediments are the outer 10% of the sediments that would be uncovered if the water level dropped sufficiently to expose 10% of the bottom of the lagoon

* The airborne concentrations estimated for these features are based on bulk measurements from deeper samples; shallow samples showed ND.

The potential sources considered in this analysis include:

- **the abandoned road and the beach in the Illinois Beach State Park and Nature Preserve.** Note that, because the beach extends for a large distance laterally northward away from the proposed sports complex site, the nearest 500 m of the beach and the entire 4500 m of beach were separately evaluated. It is also noted that, although other parts of the Illinois Beach State Park and Nature Preserve may contain asbestos, because such areas are well vegetated and almost continuously flooded, it is expected that emissions from such areas would be minimal and were not further addressed;

- **the perimeter road in the JM borrow area north of the proposed sports complex.** Note that, although the shallow sample from this road showed no detectable asbestos, the road was modeled assuming the deeper "base" material would become exposed so that we could evaluate the importance of maintaining the integrity of the surface of this road;

- **various roads, berm segments, and the beach on the JM Disposal Area NPL site east of the proposed sports complex.** For the roads, the road segment running immediately adjacent to the proposed sports complex on the western edge of the NPL site and an average of all roads over the entire NPL site were separately evaluated. Also, when modeling each road, the higher value among the shallow and deep sample was assumed, so that (as with the road in the borrow area) we could evaluate the importance of maintaining the integrity of the surfaces of these roads. Note that, except for the specific areas listed, samples from the various surfaces of the rest of the NPL site showed no detectable asbestos;

- **the swale to the west of the proposed sports complex.** The swale runs south to north and drains areas that are known or suspected to contain asbestos containing materials;

- **the unpaved shoulders and other portions of Greenwood Ave.** As with the other roads modeled, the higher values of the shallow and deep samples were employed to estimate the asbestos content for this road. The area at the eastern end of Greenwood Ave, which has been designated as Asbestos Site No. 2 and has come to the attention of regulatory agencies (JM staff, personal communication), was also evaluated. Because this area was not sampled during the field investigation, an asbestos concentration had to be assumed. In an attempt to be conservative, the highest of the concentrations observed among road base and onsite samples was assumed for Site No. 2;

- **the beach, the western yard, the sand pile, and the general property of the Midwest Generation station.** *Although not sampled extensively, the general* property of the Midwest Generation station was modeled assuming that the same level of asbestos contamination observed on the western yard exists throughout the entire property;

- **the sediment in the industrial canal.** Although the sediment in the industrial canal was not sampled during the field investigation, there are records indicating that debris may have been deposited in the canal. Therefore, to be conservative, the sediment was modeled assuming it contained asbestos concentrations equal to the highest concentrations measured in areas where substantial quantities of asbestos-containing debris were observed (i.e. in road base samples and onsite samples). Such samples actually represent the highest concentrations of asbestos observed during the entire field investigation. The sediment in the canal was also modeled in two ways: (1) assuming that 10% of the sediment was ultimately exposed due to a drop in water level in the canal and (2) assuming that 100% of the sediment was ultimately exposed due to the canal completely drying out; and

- **the sediment in the pumping lagoon.** Although sediments in the pumping lagoon were not sampled during the field investigation, asbestos concentrations were estimated for the sediments in the same manner described above for industrial canal sediments. Also in parallel with the evaluation of the industrial canal, the pumping lagoon sediments were evaluated in two ways: (1) assuming 10% of the sediments become exposed and (2) assuming 100% of the sediments become exposed.

The characteristics of each of the above-listed sources that affect potential asbestos-releases from these potential sources are summarized in Table 5-3. Estimates of the attendant airborne asbestos concentrations that might be generated at the proposed sports complex as a consequence of such releases are also indicated. Thus:

- Column 2 indicates the Sample Nos. used to derive estimated exposure concentrations for each of the potential sources evaluated. Note that, in some cases (denoted as "estd"), concentrations were estimated using a broader range of inferences (which are described above);

- Column 3 indicates the estimated surface area for each potential source;

- Column 4 indicates the width of each potential source transverse to the direction of the wind that is required to carry released asbestos from the source to the proposed sports complex;

- Column 5 indicates the distance between the closest point of each potential source and the closest point of the proposed sports complex. Note that this distance therefore represents a conservative assumption for modeling. This is because the majority of the releases from each source will occur at greater distances from the sports complex and individuals at the sports complex will spend most of their time at greater distances from the source;

- Column 6 indicates the direction that the wind must blow for asbestos released from each source to reach the proposed sports complex site;

- Column 7 indicates the fraction of the time that winds in the Waukegan area blow in the appropriate direction to transport asbestos from each source to the proposed sports complex site. This is based on an analysis of the wind rose published for O'Hare Airport in Chicago;

- Column 8 indicates the mean wind velocity for Waukegan (based on data from O'Hare Airport in Chicago);

- Column 9 indicates the mean daily fastest mile of wind for O'Hare Airport in Chicago;

- Column 10 indicates the fraction of each source area covered by vegetation;

- Column 11 indicates that bulk asbestos concentrations estimated for each source (reported as the concentration of protocol structures per gram of respirable dust);

- Column 12 indicates the fraction of such structures that are longer than 10 µm. Such longer structures are weighted more heavily than structures with lengths between 5 and 10 µm when evaluating potency and risk (Berman and Crump 1999a and b);

- Column 13 indicates the type of asbestos (chrysotile or amphibole) observed (or assumed) for each source;

- Column 14 indicates the frequency (number per month) of events that might disturb the surface of each source (i.e. individuals walking or riding over the surface). For matrices that potentially form crusts (such as soils with high silt or clay content), which can limit emissions, the overall rate of emissions is strongly dependent on the frequency of disturbance (U.S. EPA 1985);

- Column 15 indicates the mechanism of asbestos release (i.e. wind entrainment or vehicular traffic);

- Column 16 provides the estimated "maximum" airborne asbestos concentration potentially generated at the proposed sports complex attendant to each of the modeled releases. The term "maximum" is used here to indicate that this is the concentration expected assuming that the wind blows constantly and continuously in the direction required to carry asbestos from the respective source directly to the proposed sports complex; and

- Column 17 provides the estimated "average" airborne asbestos concentration potentially generated at the proposed sports complex attendant to each of the modeled releases. The term "average" is used here to indicate that this estimate is averaged over time by accounting for the fraction of time that winds blow in the direction required to carry asbestos from the respective source directly to the proposed sports complex.

To interpret the estimated airborne concentrations presented in Table 5-3, acceptable airborne asbestos concentrations (to which the estimated concentrations could be compared) were derived as described in the following section.

5.3 Evaluation of Health Consequences

As previously indicated (Section 3.3), the risks posed by exposure to asbestos are evaluated in this study using the procedures described in the protocol for assessing asbestos-related risks (Berman and Crump 1999a and b). Thus, asbestos exposure is measured and reported in terms of "protocol" structures, an exposure index that better represents biological activity than indices traditionally employed for asbestos. Protocol structures are those longer than 5 µm and thinner than 0.5 µm. Furthermore, when assessing risks, protocol structures longer than 10 µm are weighted more heavily. The relative weights assigned to protocol structures to account for their relative potency are described by the relationship given in Equation 2.2 of the protocol (Berman and Crump 1999a):

$$C_{asb} = 0.003\ C_S + 0.997C_L \qquad (5.7)$$

where:

- C_{asb} is the weighted, total concentration of protocol structures (to be used to assess risk);
- C_S is the concentration of "short" protocol structures (i.e. those between 5 µm and 10 µm in length that are thinner than 0.5 µm); and
- C_L is the concentration of "long" protocol structures (i.e. those longer than 10 µm that are thinner than 0.5 µm).

The protocol also provides risk coefficients that are matched to exposures reported using this index so that corresponding risks for lung cancer and mesothelioma can be assessed. To facilitate evaluation in this study, the recommended risk coefficients from the protocol were combined with appropriate risk assessment models for the asbestos-related diseases (also described in Berman and Crump 1999a and b) to develop appropriate risk tables for asbestos. The additional input needed to complete such a table are (1) the background mortality rates for respiratory cancer and for all causes among the general population to be evaluated and (2) the estimated duration and frequency of exposure. Background U.S. mortality rates were used to construct the tables presented here. Regarding the duration and frequency of exposure, it was assumed that visitors and users of the proposed sports complex may spend approximately 1000 hrs of time at the complex over their lifetime. This translates, for example, to 4 hrs per day for 25 days over each of 10 yrs.

Given the inputs discussed above, Table 5-4 presents estimates of the relative risk to male and female visitors to the sports complex who are exposed, respectively, to 0.0005 asbestos s/cm^3 for a total of 1000 hrs (conservatively assumed to begin at age 0). Because risk varies as a function of smoking habit and life expectancy, the sex and smoking habits of the individuals at risk from asbestos exposure are listed in the first column of Table 5-4. The cells in the remaining columns each present the additional risk per 100,000 persons from 1000 hrs of exposure to asbestos dusts containing the percent of fibers longer than 10 µm listed at the head of each respective column. Thus, for example, the risk of lung cancer to a male, non-smoker exposed for 1000 hrs to asbestos containing 100% fibers longer than 10 µm would be 0.011 (1.1 x 10^{-02}) multiplied by one in one hundred thousand or a risk of 1.1 x 10^{-7}, which is just slightly greater than one in 10 million.

To further simplify the analysis in this study, acceptable airborne concentrations (equivalent to a one in one hundred thousand risk) were derived by taking the quotient of the airborne concentration used to construct Table 5-4 (0.0005 f/cm^3) and the reciprocal of the risk estimate in each cell of the table. The resulting acceptable airborne concentrations are presented in Table 5-5.

table are (1) the background mortality rates for respiratory cancer and for all causes among the general population to be evaluated and (2) the estimated duration and frequency of exposure. Background U.S. mortality rates were used to construct the tables presented here. Regarding the duration and frequency of exposure, it was assumed that visitors and users of the proposed sports complex may spend approximately 1000 hrs of time at the complex over their lifetime. This translates, for example, to 4 hrs per day for 25 days over each of 10 yrs.

Given the inputs discussed above, Table 5-4 presents estimates of the relative risk to male and female visitors to the sports complex who are exposed, respectively, to 0.0005 asbestos s/cm^3 for a total of 1000 hrs (conservatively assumed to begin at age 0). Because risk varies as a function of smoking habit and life expectancy, the sex and smoking habits of the individuals at risk from asbestos exposure are listed in the first column of Table 5-4. The cells in the remaining columns each present the additional risk per 100,000 persons from 1000 hrs of exposure to asbestos dusts containing the percent of fibers longer than 10 μm listed at the head of each respective column. Thus, for example, the risk of lung cancer to a male, non-smoker exposed for 1000 hrs to asbestos containing 100% fibers longer than 10 μm would be 0.011 (1.1 x 10^{-02}) multiplied by one in one hundred thousand or a risk of 1.1 x 10^{-7}, which is just slightly greater than one in 10 million.

To further simplify the analysis in this study, acceptable airborne concentrations (equivalent to a one in one hundred thousand risk) were derived by taking the quotient of the airborne concentration used to construct Table 5-4 (0.0005 f/cm^3) and the reciprocal of the risk estimate in each cell of the table. The resulting acceptable airborne concentrations are presented in Table 5-5.

TABLE 5-4:
ADDITIONAL RISK PER ONE HUNDRED THOUSAND PERSONS FROM 1000 HOURS EXPOSURE (BEGINNING AT AGE 0) TO 0.0005 TEM f/cc LONGER THAN 5.0 μm AND THINNER THAN 0.5 μm

	Percent of Fibers Greater Than 10 μm in Length										
	0	0.05	0.10	0.50	1.00	2.00	5.00	10.00	20.00	50.00	100.00
						CHRYSOTILE					
MALE NON-SMOKERS											
Lung Cancer	3.4E-05	4.0E-05	4.6E-05	9.1E-05	1.5E-04	2.6E-04	6.0E-04	1.2E-03	2.3E-03	5.7E-03	1.1E-02
Mesothelioma	1.2E-04	1.4E-04	1.6E-04	3.2E-04	5.2E-04	9.3E-04	2.1E-03	4.2E-03	8.2E-03	2.0E-02	4.0E-02
Combined	1.6E-04	1.8E-04	2.1E-04	4.1E-04	6.7E-04	1.2E-03	2.7E-03	5.3E-03	1.0E-02	2.6E-02	5.2E-02
FEMALE NON-SMOKERS											
Lung Cancer	2.4E-05	2.8E-05	3.3E-05	6.5E-05	1.1E-04	1.9E-04	4.3E-04	8.3E-04	1.6E-03	4.1E-03	8.1E-03
Mesothelioma	1.3E-04	1.5E-04	1.8E-04	3.5E-04	5.7E-04	1.0E-03	2.3E-03	4.5E-03	8.9E-03	2.2E-02	4.4E-02
Combined	1.6E-04	1.8E-04	2.1E-04	4.2E-04	6.8E-04	1.2E-03	2.8E-03	5.4E-03	1.1E-02	2.6E-02	5.2E-02
MALE SMOKERS											
Lung Cancer	3.2E-04	3.7E-04	4.2E-04	8.4E-04	1.4E-03	2.4E-03	5.5E-03	1.1E-02	2.1E-02	5.3E-02	1.0E-01
Mesothelioma	8.9E-05	1.0E-04	1.2E-04	2.4E-04	3.8E-04	6.8E-04	1.6E-03	3.0E-03	6.0E-03	1.5E-02	3.0E-02
Combined	4.1E-04	4.7E-04	5.4E-04	1.1E-03	1.7E-03	3.1E-03	7.1E-03	1.4E-02	2.7E-02	6.8E-02	1.3E-01
FEMALE SMOKERS											
Lung Cancer	2.3E-04	2.6E-04	3.0E-04	6.0E-04	9.7E-04	1.7E-03	4.0E-03	7.7E-03	1.5E-02	3.8E-02	7.5E-02
Mesothelioma	1.2E-04	1.4E-04	1.6E-04	3.2E-04	5.2E-04	9.2E-04	2.1E-03	4.1E-03	8.1E-03	2.0E-02	4.0E-02
Combined	3.5E-04	4.0E-04	4.6E-04	9.2E-04	1.5E-03	2.6E-03	6.1E-03	1.2E-02	2.3E-02	5.8E-02	1.2E-01
						AMPHIBOLE					
MALE NON-SMOKERS											
Lung Cancer	1.0E-04	1.2E-04	1.4E-04	2.8E-04	4.5E-04	7.9E-04	1.8E-03	3.5E-03	7.0E-03	1.7E-02	3.4E-02
Mesothelioma	1.2E-02	1.4E-02	1.6E-02	3.2E-02	5.2E-02	9.3E-02	2.1E-01	4.2E-01	8.2E-01	2.0E+00	4.0E+00
Combined	1.2E-02	1.4E-02	1.6E-02	3.3E-02	5.3E-02	9.4E-02	2.2E-01	4.2E-01	8.3E-01	2.0E+00	4.1E+00
FEMALE NON-SMOKERS											
Lung Cancer	7.6E-05	8.9E-05	1.0E-04	2.0E-04	3.3E-04	5.8E-04	1.3E-03	2.6E-03	5.1E-03	1.3E-02	2.5E-02
Mesothelioma	1.3E-02	1.5E-02	1.8E-02	3.5E-02	5.7E-02	1.0E-01	2.3E-01	4.5E-01	8.9E-01	2.2E+00	4.4E+00
Combined	1.3E-02	1.6E-02	1.8E-02	3.5E-02	5.8E-02	1.0E-01	2.3E-01	4.6E-01	9.0E-01	2.2E+00	4.4E+00
MALE SMOKERS											
Lung Cancer	1.2E-03	1.4E-03	1.6E-03	3.3E-03	5.3E-03	9.4E-03	2.2E-02	4.2E-02	8.3E-02	2.1E-01	4.1E-01
Mesothelioma	8.9E-03	1.0E-02	1.2E-02	2.4E-02	3.8E-02	6.8E-02	1.6E-01	3.0E-01	6.0E-01	1.5E+00	3.0E+00
Combined	1.0E-02	1.2E-02	1.4E-02	2.7E-02	4.4E-02	7.7E-02	1.8E-01	3.5E-01	6.8E-01	1.7E+00	3.4E+00
FEMALE SMOKERS											
Lung Cancer	9.2E-04	1.1E-03	1.2E-03	2.4E-03	4.0E-03	7.0E-03	1.6E-02	3.1E-02	6.2E-02	1.5E-01	3.0E-01
Mesothelioma	1.2E-02	1.4E-02	1.6E-02	3.2E-02	5.2E-02	9.2E-02	2.1E-01	4.1E-01	8.1E-01	2.0E+00	4.0E+00
Combined	1.3E-02	1.5E-02	1.7E-02	3.5E-02	5.6E-02	9.9E-02	2.3E-01	4.4E-01	8.8E-01	2.2E+00	4.3E+00

TABLE 5-5:
AIR CONCENTRATIONS OF PROTOCOL STRUCTURES LONGER THAN 5 UM EQUIVALENT TO A ONE IN ONE HUNDRED THOUSAND RISK
(Assumes 1000 hrs of exposure beginning at age 0)

	Percent of Fibers Greater Than 10 mm in Length										
	0	0.05	0.1	0.5	1	2	5	10	20	50	100
					CHRYSOTILE						
MALE NON-SMOKERS											
Lung Cancer	1.5E+01	1.3E+01	1.1E+01	5.5E+00	3.4E+00	1.9E+00	8.3E-01	4.3E-01	2.2E-01	8.8E-02	4.4E-02
Mesothelioma	4.1E+00	3.5E+00	3.1E+00	1.5E+00	9.5E-01	5.4E-01	2.3E-01	1.2E-01	6.1E-02	2.5E-02	1.2E-02
Combined	3.2E+00	2.8E+00	2.4E+00	1.2E+00	7.4E-01	4.2E-01	1.8E-01	9.4E-02	4.8E-02	1.9E-02	9.7E-03
FEMALE NON-SMOKERS											
Lung Cancer	2.0E+01	1.8E+01	1.5E+01	7.7E+00	4.7E+00	2.7E+00	1.2E+00	6.0E-01	3.0E-01	1.2E-01	6.2E-02
Mesothelioma	3.8E+00	3.2E+00	2.8E+00	1.4E+00	8.7E-01	4.9E-01	2.1E-01	1.1E-01	5.6E-02	2.3E-02	1.1E-02
Combined	3.2E+00	2.7E+00	2.4E+00	1.2E+00	7.4E-01	4.2E-01	1.8E-01	9.3E-02	4.7E-02	1.9E-02	9.6E-03
MALE SMOKERS											
Lung Cancer	1.6E+00	1.4E+00	1.2E+00	6.0E-01	3.7E-01	2.1E-01	9.0E-02	4.6E-02	2.4E-02	9.5E-03	4.8E-03
Mesothelioma	5.6E+00	4.8E+00	4.2E+00	2.1E+00	1.3E+00	7.3E-01	3.2E-01	1.6E-01	8.3E-02	3.4E-02	1.7E-02
Combined	**1.2E+00**	**1.1E+00**	**9.3E-01**	**4.6E-01**	**2.9E-01**	**1.6E-01**	**7.0E-02**	**3.6E-02**	**1.8E-02**	**7.4E-03**	**3.7E-03**
FEMALE SMOKERS											
Lung Cancer	2.2E+00	1.9E+00	1.7E+00	8.4E-01	5.2E-01	2.9E-01	1.3E-01	6.5E-02	3.3E-02	1.3E-02	6.7E-03
Mesothelioma	4.1E+00	3.5E+00	3.1E+00	1.6E+00	9.6E-01	5.4E-01	2.4E-01	1.2E-01	6.1E-02	2.5E-02	1.2E-02
Combined	1.4E+00	1.2E+00	1.1E+00	5.4E-01	3.3E-01	1.9E-01	8.2E-02	4.2E-02	2.1E-02	8.7E-03	4.3E-03
					AMPHIBOLE						
MALE NON-SMOKERS											
Lung Cancer	4.8E+00	4.1E+00	3.6E+00	1.8E+00	1.1E+00	6.3E-01	2.7E-01	1.4E-01	7.2E-02	2.9E-02	1.5E-02
Mesothelioma	4.1E-02	3.5E-02	3.1E-02	1.5E-02	9.5E-03	5.4E-03	2.3E-03	1.2E-03	6.1E-04	2.5E-04	1.2E-04
Combined	4.1E-02	3.5E-02	3.1E-02	1.5E-02	9.4E-03	5.3E-03	2.3E-03	1.2E-03	6.1E-04	2.4E-04	1.2E-04
FEMALE NON-SMOKERS											
Lung Cancer	6.6E+00	5.6E+00	4.9E+00	2.5E+00	1.5E+00	8.6E-01	3.7E-01	1.9E-01	9.8E-02	3.9E-02	2.0E-02
Mesothelioma	3.8E-02	3.2E-02	2.8E-02	1.4E-02	8.7E-03	4.9E-03	2.1E-03	1.1E-03	5.6E-04	2.3E-04	1.1E-04
Combined	**3.7E-02**	**3.2E-02**	**2.8E-02**	**1.4E-02**	**8.7E-03**	**4.9E-03**	**2.1E-03**	**1.1E-03**	**5.6E-04**	**2.2E-04**	**1.1E-04**
MALE SMOKERS											
Lung Cancer	4.1E-01	3.5E-01	3.0E-01	1.5E-01	9.4E-02	5.3E-02	2.3E-02	1.2E-02	6.0E-03	2.4E-03	1.2E-03
Mesothelioma	5.6E-02	4.8E-02	4.2E-02	2.1E-02	1.3E-02	7.3E-03	3.2E-03	1.6E-03	8.3E-04	3.4E-04	1.7E-04
Combined	4.9E-02	4.2E-02	3.7E-02	1.9E-02	1.1E-02	6.5E-03	2.8E-03	1.4E-03	7.3E-04	3.0E-04	1.5E-04
FEMALE SMOKERS											
Lung Cancer	*5.5E-01*	*4.7E-01*	*4.1E-01*	*2.1E-01*	*1.3E-01*	*7.1E-02*	*3.1E-02*	*1.6E-02*	*8.1E-03*	*3.3E-03*	*1.6E-03*
Mesothelioma	4.1E-02	3.5E-02	3.1E-02	1.6E-02	9.6E-03	5.4E-03	2.4E-03	1.2E-03	6.1E-04	2.5E-04	1.2E-04
Combined	3.8E-02	3.3E-02	2.9E-02	1.4E-02	8.9E-03	5.0E-03	2.2E-03	1.1E-03	5.7E-04	2.3E-04	1.2E-04

To assure that our analysis would be health protective of all potential visitors to the proposed sports complex (male or female, smoker or not), we completed our analysis by comparing the predicted airborne asbestos concentrations presented in Table 5-3 with the lowest (most conservative) values for acceptable airborne concentrations presented in Table 5-5. Thus, for chrysotile exposures, we determined whether predicted exposures were less than the acceptable airborne concentrations estimated for combined (lung cancer and mesothelioma) risk to male smokers. These are the values presented in the highlighted row in the top half of the table. Similarly, for amphibole exposures, we compared predicted exposures to airborne concentrations presented for combined risk to male smokers, which are in the highlighted row in the lower half of Table 5-4.

Given that predicted exposures in Table 5-3 appear to contain a maximum of approximately 60% structures longer than 10 μm, we conclude, based on an extrapolation from Table 5-5, that acceptable airborne concentrations need to be less than 6.2×10^{-3} f/cm^3 for chrysotile and less than 1.9×10^{-4} f/cm^3 for amphiboles.

Comparisons between predicted exposures listed in Table 5-3 and the target acceptable airborne asbestos concentrations provided in the last paragraph are instructive. With the exception of several of the roadways evaluated and the sediments in the pumping lagoon and the industrial canal, none of the other sources of asbestos evaluated appear to contain asbestos at sufficient concentrations or are sufficiently close to the proposed sports complex site to pose an unacceptable risk to future visitors or users of the site (i.e. none of the airborne exposure concentrations predicted for these other sources exceed the acceptable targets).

> Note, unlike the situation for criteria pollutants, background airborne asbestos concentrations for amphiboles are generally considered to be near zero so that estimated exposure levels do not need to be adjusted to account for background. Although measurable background concentrations of chrysotile have been

reported for many urban and rural areas, it is the amphiboles that have been shown to drive risk in this study and background concentrations of amphiboles are generally considered nil. Therefore, background concentrations of asbestos are not further addressed.

Among the roadways evaluated, emissions from the shoulders of Greenwood Ave. can potentially produce airborne concentrations of asbestos at the proposed sports complex site that exceed acceptable levels, even when evaluated using the most realistic (least conservative) exposure assumptions. That Greenwood Ave. potentially contributes so substantially to airborne exposure at the proposed sports complex is likely due to a combination of proximity to the proposed sports complex site, the detection of relatively high concentrations of asbestos in surface material associated with the Avenue, and the relatively high frequency of traffic projected. Given that use of Greenwood Ave. will likely increase with completion of the sports complex and that individuals driving or parking on the avenue may be exposed to even higher airborne concentrations than those projected for the sports complex site, it may be prudent to pave or cover the remaining portions of Greenwood Ave. and its associated shoulders that are not already paved.

Emissions from the unpaved road in the borrow area of the JM property and on the JM disposal area NPL site are also potentially capable of producing airborne asbestos concentrations at the proposed sports complex that may be instantaneously unacceptable, but may be acceptable when averaged over time. More directly, when vehicles are actually traversing these roads and winds are blowing toward the sports complex, the resulting airborne concentrations at the proposed sports complex may exceed levels that (if sustained for long periods of time) would not be considered acceptable. However, traffic on these roads is limited to periodic inspections. Therefore, given that the frequency of traffic on these roads is reported to be extremely low and is projected to remain similarly low in the future, long term average emissions

ch roads may not pose an unacceptable hazard to future visitors and users of
posed complex.

ortantly, evaluation of emissions from the roads in the borrow area and on the NPL e were performed assuming that the higher concentrations of asbestos (observed only in the deep samples from these roads) would become exposed at the surface. In fact, only one of these roads (the road running onto the NPL site from the site of the proposed sports complex) currently show any detectable asbestos in the shallow, surface material (Sample No. 3R). Therefore, proper maintenance of clean cover on these roads will also adequately mitigate any potential concern associated with emissions from these roads.

Neither the sediments in the pumping lagoon nor in the industrial canal were sampled as part of the field investigation. Therefore, asbestos concentrations in these sediments had to be assumed. Due both to proximity and to the discharge of water from the JM property into these waterways, it is possible that asbestos-containing debris is present in these sediments. To be conservative, in the evaluation of sediments from these waterways, we assumed that concentrations may conceivably be equivalent to the highest concentrations observed in the current field investigation. Therefore, before any activities might be planned or altered based on the findings presented here, it is recommended that the sediments first be sampled, that the exposure pathways addressed be reevaluated, and that corresponding recommendations be modified based on the revised evaluation using actual measurements.

Based on assud asbestos concentrations (derived as described above), results from the current evation suggest that, should sediments from either the pumping lagoon or the industrianal become completely exposed (i.e. should either or both water bodies completedry out), then wind entrainment from either of these sources may result in unaccble airborne concentrations at the proposed sports complex site (when wind is blowing in the direction required to transport asbestos from either source to the sports complex site). It may therefore be prudent to maintain water levels in the lagoon and canal. As indicated above, however, it is recommended that the sediments be sampled and our evaluation revised using the resulting measurements, before any plans or activities that might result in the drying out of such sediments be considered.

5.4 Findings Regarding Asbestos

During the field investigation, asbestos was found in several surface and subsurface matrices in the vicinity of the proposed sports complex including:

- the sand pile, and western yard of the Midwest Generation Station property;
- a swale running south to north on the western edge of the proposed sports complex;
- the beaches on the Illinois Beach State Park and Nature Preserve and the JM Disposal Area NPL Site;
- the berm running between the JM Disposal Area NPL Site and the Illinois Beach State Park and Nature Preserve;
- the deeper, base-strata of NPL site roads and JM borrow area roads and the shallower, surface-strata of roads on the NPL site immediately adjacent to the proposed sports complex site; and
- the shoulders of Greenwood Ave.

Although not sampled, given the history of construction and flow into the industrial canal and pumping lagoon, it is also assumed that sediments in these water bodies also contain asbestos.

Results from the field investigation also indicate that:

- both chrysotile and amphibole asbestos (primarily crocidolite with some amosite) are observed in the majority of samples analyzed. Furthermore, particularly for samples collected in the borrow area and the disposal area NPL site of the former JM manufacturing facility property, crocidolite and chrysotile are found at similar concentrations;

- concentrations of asbestos (when observed) varied over three orders of magnitude for each asbestos type (from approximately 3×10^6 s/g_{PM10} to approximately 2×10^9 s/g_{PM10}); and

- the precision of individual concentration measurements in the matrices tested is probably good to within a factor two or three.

By modeling the release and transport of asbestos from these sources to estimate the attendant airborne exposure concentrations at the proposed sports complex and comparing the estimated exposures to appropriate health-related criteria, the hazard posed by such asbestos to future users of the sports complex was evaluated. Results indicate with only a few exceptions, the asbestos present in the matrices sampled do not pose an unacceptable risk to future users of the proposed sports complex. Moreover, for all but one of these exceptions, the projected risks are hypothetical and would occur in the future only if certain changes occur at the site. These findings are summarized in Table 5-6.

TABLE 5-6:

SUMMARY OF EXPOSURE PATHWAYS REQUIRING CLOSER SCRUTINY

Source Location	***Actual Current Condition***	***Hypothetical Future Condition***
Greenwood Ave.	Asbestos in the shallow material on the shoulders and other unpaved portions of Greenwood Ave. may currently contribute unacceptably to airborne concentrations at the site of the future sports complex.	Especially given expected increases in future traffic flow, unless managed, asbestos in the shallow material of Greenwood Ave. would likely contribute unacceptably to airborne concentrations at the proposed sports complex.
Roads in the JM Borrow Area and JM Disposal Area NPL Site	**Not currently an issue.**	Should the relatively clean surfaces of these roads not be maintained, the relatively contaminated material underlying the current surficial material could eventually become exposed and contribute unacceptably to airborne asbestos concentrations at the proposed sports complex.
Sediments in the Industrial Canal and Pumping Lagoon	**Not currently an issue.**	If asbestos exists within these sediments (which is possible, but needs to be demonstrated by measurement) and if the water levels in these areas were lowered, sediments in these areas could become exposed and contribute unacceptably to airborne asbestos concentrations at the proposed sports complex.

For the few cases in which asbestos may potentially pose an unacceptable risk, simple engineering fixes can be applied:

- asbestos currently found in the shoulders of Greenwood Ave. can potentially be introduced to the air due to vehicular traffic or wind entrainment in sufficient concentrations to pose a hazard to future users of the sports complex. It is therefore recommended that the entire right-of-way for Greenwood Ave. (east of Pershing Ave.) be paved/covered;

- hypothetically, asbestos in the deeper-strata of the roads on the JM Disposal Area NPL Site and the JM Borrow Area, if brought to the surface and released to the air due to vehicular traffic could pose an unacceptable hazard to future sports complex users. It is therefore recommended that the clean, shallow surfacing material on these roads be maintained in good repair; and

- hypothetically, projected concentrations of asbestos in the sediments of the industrial canal and pumping lagoon, if such sediments were to become exposed and dry out, might be released to the air due to wind entrainment at sufficient concentrations to pose an unacceptable risk to future sports complex users. It is therefore recommended that water in the canal and lagoon be maintained at present levels. Note that, if there is a need to drain either of these water bodies in the future, it is recommended that sediments first be sampled to determine whether protective measures will be required to protect the public from any asbestos that may actually be present in these materials. At this time, there is no proof that asbestos exists within these sediments because they were not sampled.

Importantly, although the limited sampling conducted during the field investigation was not designed to determine the overall distribution of asbestos in any of the matrices sampled, sampling was conducted in a manner allowing determination of likely mean concentrations with reasonable precision. Coupled with the use of conservative (health protective) assumptions regarding the choice of asbestos concentration estimates and other input parameters for emission and dispersion modeling, the risks posed by the asbestos observed in surface and near-surface materials in the vicinity of the proposed sports complex are unlikely to have been underestimated.

5.5 Lead Investigation

As previously indicated, samples collected for the determination of asbestos were also analyzed for lead to provide a general indication of the extent of lead contamination in the immediate vicinity of the proposed sports complex. These analyses were performed because discussions with JM personnel and review of plant records indicated that the form of lead used in a gasket-making operation in Building A was a finely divided powder so that lead deposition beyond the plant boundaries may have occurred due both to air dispersion and due to contamination of waste material deposited in such places as the JM Disposal Area NPL site. Results from the analysis for lead of the 19 offsite composite samples are presented in Table 5-7.

In Table 5-7, Column 1 indicates the sample identification number; Column 2 provides a brief description of the location from which each sample composite was collected; and Column 3 indicates the concentration of lead observed in each sample (in ppm).

As a frame of reference for evaluating the lead measurements provided in Table 5-7, the Illinois EPA (IEPA) cleanup objective for lead in soil that applies to both residential and industrial land uses is 400 ppm. It can be seen from the table that only two samples are even close to the IEPA cleanup objective (Samples 5RS and 5RD) and only one of these (Sample 5RD) marginally exceeds the standard. Given sampling and analytical variation, however, it is not clear that the difference in lead concentrations measured in these two samples is significant. Therefore, they are considered together.

The two potentially high lead samples observed during this investigation are the shallow and deep sample composites collected from the shoulders of Greenwood Ave, which show 380 and 420 ppm, respectively. It is interesting that the only potentially high lead samples observed are associated with a roadway because elevated lead levels have commonly been observed along the shoulders of roadways due to past use of leaded gasoline. Thus, this finding is not unusual. Therefore, given that (1) lead levels

Table 5-7:

Lead Sampling Results from Offsite Soil Locations

Near the Proposed Sports Complex for Waukegan, Illinois

Sample Number	Location	Concentration (ppm)
1RS	Road on DNR property (IBSP) - shallow	23
1RD	Road on DNR property (IBSP) - deep	21
2RS	Road in southeast corner of property - shallow	29
2RD	Road in southeast corner of property - deep	50
3RS	Road in southeast corner of setling basin - shallow	<10
3RD	Road in southeast corner of setling basin - deep	<10
4RS	Road east of borrow pit - shallow	13
4RD	Road east of borrow pit - deep	28
5RS	Greenwood Ave. (west from power plant) - shallow	380
5RD	Greenwood Ave. (west from power plant) - deep	420
1D	Berm to east of NPL site	15
2D	Berm north of industrial canal by DNR	<10
3D	Berm between industrial canal and NPL landfill	30
1B	DNR beach sample (IBSP)	<10
2B	JM/NPL property beach sample	<10
1L	NPL landfill cap west of settling basin	17
2L	NPL landfill cap sousth of settling basis	23
S1	Swale - west of property	150
1CE	ComEd Property	67

observed during this investigation are all well below the IEPA lead objective for both urban and residential land use (with the exception of the samples collected along Greenwood Ave); (2) that even the levels observed on Greenwood Ave are only marginally elevated in comparison with the IEPA lead objective; and (3) it is not uncommon to observe elevated lead levels in association with roadways, it does not appear that lead in bulk matrices near the proposed sports complex pose an unacceptable hazard. Therefore, lead need not be further addressed.

Note, as indicated in Chapter 6, we recommend that the entire right-of-way (including the shoulders) of Greenwood Ave. (east of Pershing Ave) be paved or covered. Thus, the locations at which the highest lead concentrations were observed in this study would also be addressed by that recommendation.

6. GENERAL CONCLUSIONS

This study investigated potential health-related effects that might be experienced by users of the proposed sports complex that are attributable to airborne transport of air pollutants from industrial facilities and asbestos and lead in surface and near-surface soils in the general vicinity. Due to differences in the manner in which they are regulated, criteria pollutants, non-criteria pollutants, and asbestos were separately evaluated. Lead in neighboring soils was also evaluated.

Results from the completed analysis of criteria pollutants show that short-term carbon monoxide (CO), particulate matter (PM_{10}), Lead (Pb), and sulfur dioxide (SO_2) concentrations, when combined with their corresponding background concentrations and compared to the appropriate National Ambient Air Quality Standard (NAAQS), should not pose a risk to users at the site. Annual nitrogen dioxide (NO_2) concentrations were also found to be in compliance with the corresponding NAAQS. Furthermore, although short-term NO_2 concentrations were found to exceed a California standard, the likelihood that the predicted exceedances will occur in the future is extremely remote and, even if they do occur, they would not contribute unacceptably to increased risk for future park users.

Results from the analysis of non-criteria pollutants indicate that (with one exception) none of the non-criteria pollutants emitted from facilities within a five-mile radius of the proposed sports complex pose an unacceptable risk to future users of the complex for acute effects, chronic, non-cancer effects, or cancer. Regarding the one exception, based on the current analysis, it is not possible to assure that acrolein emitted from the OMC/Bombardier facilities will not pose an unacceptable, acute hazard to users of the proposed sports complex. However, before a final determination is made concerning such emissions, it is strongly recommended that emission estimates from these facilities be reevaluated. If the emissions are confirmed to be accurate, then a more sophisticated (Level III) analysis should be performed to determine whether emissions from these two facilities may in fact contribute unacceptably to acute hazards at the proposed sports complex.

Results from modeling release and transport of asbestos indicate that, with only a few exceptions, the asbestos present in the matrices sampled do not pose an unacceptable risk to future users of the proposed sports complex. Moreover, for all but one of these exceptions, the projected risks are hypothetical and would occur in the future only if certain changes occur at the site (see Table 5-6).

For the few cases in which asbestos may potentially pose an unacceptable risk, simple engineering fixes can be applied:

- asbestos currently found in the shoulders of Greenwood Ave. can potentially be introduced to the air due to vehicular traffic or wind entrainment in sufficient concentrations to pose a hazard to future users of the sports complex. It is therefore recommended that the entire right-of-way for Greenwood Ave. (east of Pershing Ave.) be paved/covered. Note that this recommendation would also address questions concerning lead that are discussed in Section 5.5;

- hypothetically, asbestos in the deeper-strata of the roads on the JM Disposal Area NPL Site and the JM Borrow Area, if brought to the surface and released to the air due to vehicular traffic could pose an unacceptable hazard to future sports complex users. It is therefore recommended that the clean, shallow surfacing material on these roads be maintained in good repair; and

- hypothetically, projected concentrations of asbestos in the sediments of the industrial canal and pumping lagoon, if such sediments were to become exposed and dry out, might be released to the air due to wind entrainment at sufficient concentrations to pose an unacceptable risk to future sports complex users. It is therefore recommended that water in the canal and lagoon be maintained at present levels. Note that, if there is a need to drain either of these water bodies in the future, it is recommended that sediments first be sampled to determine whether protective measures will be required to protect the public from any asbestos that may actually be present in these materials. At this time, there is no proof that asbestos exists within these sediments because they were not sampled.

Results from comparing observed lead concentrations with corresponding standards indicate that lead does not pose an unacceptable risk to future users of the proposed sports complex.

7. REFERENCES

Auer, AH, Jr. (1978) "Correlation of Land Use and Cover with Meteorological Anomalies." *Journal of Applied Meteorology.* May, pages 636 - 643.

Berman, D.W. and Kolk, A.J. *Draft: Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Materials, Revision 1.* Submitted to the U.S. Environmental Protection Agency, Region 8. May 23, 2000.

Berman, D.W. "Asbestos Measurement in Soils and Bulk Materials: Sensitivity, Precision, and Interpretation -- You *Can* Have It All." in *Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342,* M.E. Beard, H.L. Rook, Eds., American Society for Testing and Materials. Pp. 70-89. 2000.

Berman, D.W. and Crump, K.S. *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites. Part 1: Protocol.* Prepared for: Kent Kitchingman, U.S. Environmental Protection Agency, Region 9, 75 Hawthorne, San Francisco, California 94105. 1999a. Under EPA Review.

Berman, D.W. and Crump, K.S. *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites. Part 2: Technical Background Document.* Prepared for: Kent Kitchingman, U.S. Environmental Protection Agency, Region 9, 75 Hawthorne, San Francisco, California 94105. 1999b. Under EPA Review.

Berman, D.W. and Kolk, A.J. *Superfund Method for the Determination of Asbestos in Soils and Bulk Materials.* Prepared for the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. EPA 540-R-97-028. 1997.

Center for Disease Control. "Section II: The Burden of Cardiovascular Diseases, Cancer, and Diabetes" in *Chronic Diseases and Their Risk Factors. The Nation's*

Leading Causes of Death. http://www.cdc.gov/nccdphp/statbook/statbook.htm. December, 1999.

Cowherd, C. Jr.; Muleski, GE; Englehart, P; Gillette, DA; *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites.* Office of Health and Environmental Assessment; Office of Research and Development; US Environmental Protection Agency, Washington, DC 20460. EPA/600/8-85/002, 1985.

Illinois Environmental Protection Agency (2000) *Illinois Annual Air Quality Report 2000 Springfield, Illinois.* IEPA, Bureau of Air. IEPA/BOA/01-007.

Kumar Malhotra & Associates, Inc. *Final. Remedial Investigation Report: Johns-Manville Disposal Area, Waukegan, Illinois.* Volume I, July 1985.

Turner, D.B. (1970), *Workbook of Atmospheric Dispersion Estimates,* U.S. Department of Health, Education, and Welfare, Cincinnati, OH.

U.S. Environmental Protection Agency (???). SW-846. **Finish.**

U.S. Environmental Protection Agency (2001a). *Guidance for Reporting Toxic Chemicals: Polycyclic Aromatic Compounds Category.* Office of Information. EPA 745-B-01-00X.

U.S. Environmental Protection Agency (2001b). *Preliminary Remediation Goals (PRGs).* U.S. EPA Region 9. http://www.epa.gov/Region9/waste/sfund/prg/index.html.

U.S. Environmental Protection Agency (2000a) *Integrated Risk Information System.* U.S. EPA, Office of Research and Development. http://www.epa.gov/docs/ngispgm3/iris/index.html.

U.S. Environmental Protection Agency (2000b) *EPA Region 3 Risk-Based Concentration Table*. Philadelphia, PA: U.S. EPA, Region 3, Superfund Technical Support Section. April 13, 2000.

U.S. Environmental Protection Agency (2000c) *Guidance for Reporting Toxic Chemicals within the Dioxin and Dioxin-like Compounds Category*. Office of Information EPA-745-B-00-021.

U.S. Environmental Protection Agency (1997a) *Exposure Factors Handbook, Volume I, General Factors*. Washington, DC: U.S. EPA, Office of Research and Development. EPA/600/P-95/002Fa.

U.S. Environmental Protection Agency (1997b) *Health Effects Assessment Summary Tables*. Washington, DC: U.S. EPA, Office of Solid Waste and Emergency Response. EPA-540-R-97-036.

U.S. Environmental Protection Agency (1995) *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume I – User Instructions*. Research Triangle Park, North Carolina. U.S. EPA, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division. EPA-454/B-95-003a.

U.S. Environmental Protection Agency (1995) *SCREEN3 Model User's Guide*. Research Triangle Park, North Carolina. U.S. EPA, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division. EPA-454/B-95-004.

U.S. Environmental Protection Agency (1989) *Interim procedures for estimating risks associated with exposures to mixtures of chlorinated dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs) and 1989 update*. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC; EPA/625/3-89/016.

U.S. Environmental Protection Agency (1985), *Compilation of Air Pollution Emission Factors., Volume 1: Stationary, Point, and Area Sources.* AP-42, Fourth Edition. Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

U.S. Environmental Protection Agency (1972) *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States.* Research Triangle Park, North Carolina. U.S. EPA, Office of Air Programs.

The Waukegan Historical Society. *A Brief Overview of the Waukegan Factory, 1918-1986.* Prepared October, 2001.

APPENDIX A

SOURCES OF AIR POLLUTANTS IN THE VICINITY OF THE PROPOSED SPORTS COMPLEX

APPENDIX A
Sources of Air Pollutants in the Vicinity of the Proposed Sports Complex

Reference Map ID (Fig. 3-4)	Facility	UTM E	UTM N	Distance km	Distance mi	Direction	Pollutants of Concern: Asbestos	Criteria	Non-Criteria
A	NPL SITE	433230	4693000	0.38	0.24	E	X		
B	THE NATURE PRESERVE	433500	4693500	0.82	0.51	N	X		
C	MIDWEST GENERATION - SAND PILE	433385	4692230	0.94	0.58	SE	X		
D	MIDWEST GENERATION - WESTERN YARD	432346	4692500	0.71	0.44	S	X		
13	ABBOTT LABS-N. CHICAGO PLANT	431000.0	4686789.1	6.48	4.03	S		SO2, PM, NOx, CO	Di-(2-Ethylhexyl) Phthalate, Hydrocloric Acid, Mercury Compounds, Methanol, Methylene Chloride, Dioxins
31	ACE	426500.0	4697800.0	7.96	4.94	NW		PM	
19	ALLEGIANCE HEALTHCARE	426200.0	4686900.0	9.02	5.61	SW		SO2, PM, NOx, CO	
30	AVERY-DENNISON COMMERCIAL PRODUCTS DIV.	427002.9	4694171.1	5.96	3.70	NW		NOx	Methylene Chloride
27	BASF/PPG INDUSTRIES	426914.7	4692290.0	5.97	3.71	W		SO2, PM, NOx, CO	Ethylene Oxide, Propylene Oxide, Methanol, Cresol (Mixed Isomers)
3	CHERRY ELECTRICAL PRODUCTS CORP.	432511.1	4691586.3	1.45	0.90	S		NOx, CO	Toluene
32	COM ED - ZION	433800.9	4699779.1	6.85	4.25	N		SO2, PM, NOx, CO	
24	CORAL CHEMICAL CO.	427450.0	4690200.0	6.08	3.78	W			Hydrogen Fluoride, Glycol Ethers
20	COSMED OF ILLINOIS	427000.0	4687500.0	8.03	4.99	SW			Ethylene Oxide
10	DEXTER CORP./AKZO NOBEL	432077.0	4689538.0	3.55	2.20	S		PM	Ethylbenzene, Methyl Isobutyl Ketone, Toluene, Phenol, Xylene (mixed Isomers), Formaldehyde, N,N-Dimethylformamide,N-Butyl Alcohol, Methyl Ethyl Ketone, 4,4'-Isopropylidenediphenol, N-Methyl-2-Pyrrolidone, Glycol Ethers, Diisocyanates, Barium Compounds, Zinc Compounds, Chromium Compounds
29	DOMINO AMJET INC.	425750.0	4692000.0	7.17	4.45	W			Methyl Ethyl Ketone, Methanol
15	EMCO CHEMICAL DISTRIBUTORS, INC	430237.7	4686087.2	7.39	4.59	S		SO2, PM, NOx, CO	N-Butyl Alcohol, Dibutyl Phthalate, Dichloromethane, Ethylbenzene, Glycol Ethers, N-Hexane, Hydrochloric Acid, Isopropyl Alcohol, Methanol, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Naphthalene, Tetrachloroethylene, Trichloroethylene, 1,2,4-Trimethylbenzene, Toluene, Xylene (Mixed Isomers)
16	FANSTEEL, INC./FEDERAL DIE CASTING CO.	428914.3	4686685.3	7.44	4.62	SW		NOX, CO	Aluminum
28	GALLAGHER CORP.	425750.0	4692100.0	7.15	4.44	W			Formaldehyde, 4,4-Methylene Dephenyl Diisocyante, Phenol, Trichloroethylene, Toluene
18	GILLETTE CO. - N. CHICAGO PLANT	427550.0	4686700.0	8.23	5.11	SW		PM, NOx, CO	Ammonia, Hydrocholoric Acid, Methanol
7	LAFARGE CORP.	432300.0	4690600.0	2.46	1.53	S		PM	
11	LAKE SHORE FOUNDRY	432000.0	4689100.0	3.99	2.48	S		PM, NOx, CO	
2	LAKESIDE/KINDER MORGAN - PROPOSED	432167.4	4691401.4	1.74	1.08	S		SO2, PM, NOx, CO	
21	MEYER MATERIAL CO.	427999.4	4688793.4	6.42	3.99	SW		PM, NOx, CO	
1	MIDWEST GENERATION - WAUKEGAN STATION	433135.0	4692290.0	0.77	0.48	S		SO2, PM, NOx, CO, Pb	Hydrogen Chloride, Hydrogen Fluoride, Sulfuric Acid, Chromium Compounds, Copper Compounds, Lead, Manganese Compounds, Mercury, Nickel Compounds, Polycyclic Aromatic Compounds, Dioxins & Related Compounds (as I-TEQs)
8	NATIONAL GYPSUM CO.	432131.4	4690171.1	2.92	1.81	S		SO2, PM, NOx, CO	
12	NORTH SHORE PRINTERS	431710.0	4689188.1	3.98	2.47	S		NOx	
4	NORTH SHORE SANITARY DISTRICT - PROPOSED	432846.0	4691538.0	1.46	0.91	S		SO2, PM, NOx, CO	
9	NOSCO, INC.	431377.7	4690301.8	3.07	1.91	S		NOx	
6	OUTBOARD MARINE CORP./BOMBARDIER RECREATIONAL PRODUCTS - PLANT 1	432538.0	4690261.0	2.76	1.71	S		SO2, PM, NOx, CO	Crotonaldehyde, Xylene (mixed Isomers), 2,2,4-Trimethylpentane, Methyl tert-butyl ether, Methyl Ethyl Ketone, Hexane, Glycol Ethers, Formaldehyde, Ethylbenzene, Cumene, O-Xylene, Propionaldehyde, Acealdehyde, Acrolein, Benzene, Toluene, Chromium Compounds, 1,3 Butadiene, M&P Xylene, P-Xylene
5	OUTBOARD MARINE CORP./BOMBARDIER RECREATIONAL PRODUCTS - PLANT 2	432500.0	4690961.0	2.07	1.29	S		SO2, PM, NOx, CO	Xylene (mixed Isomers), Ethylbenzene, Glycol Ethers, Di-2-Ethylhexyl Phthalate, Manganese, Methanol, Toulene, Chromium, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Dibutyl Phthalate, Nickel
22	PFANSTHIEL LABORATORIES	430100.0	4689400.0	4.53	2.81	SW		PM, NOx, CO	Methanol, N-Hexane, Acetonitrile, Toluene
17	R. LAVIN & SONS, INC.	428014.0	4687991.3	6.96	4.32	S		SO2, PM, NOx, CO	Zinc Compounds, Copper, Lead, Manganese, Nickel
25	ROQUETTE AMERICA, INC.	424709.4	4691388.3	8.29	5.15	W		PM, NOx, CO	Nickel
23	ST. THERESE MEDICAL CENTER/PROVENA	428810.2	4689772.2	5.17	3.21	SW		SO2, PM, NOx, CO	Ethylene Oxide
14	STONE CONTAINER CORP.-N. CHICAGO PLANT	431109.6	4686294.5	6.93	4.30	S		PM, NOx, CO	Vinyl Acetate, Hydroquinone, Ethyl Acrylate, Acetaldehyde, Formaldehyde, Glycol Ethers, Hexane, Methanol, Styrene, Toluene
26	VICTORY MEMORIAL HOSPITAL	431415.1	4691782.1	1.88	1.17	W		NOx, CO	Ethylene Oxide

APPENDIX B

ANNUAL SUMMARY OF FIVE YEARS OF ISCST3 MODEL RUNS

APPENDIX B
Waukegan Park District
Annual Summary of Five Years of ISCST3 Model Runs
for Five Criteria Pollutants

			1987		1988		1989		1990		1991	
	Averaging		Concentration	Event	Concentration	Event	Concentration	Event	Concentration	Event	Concentration	Event
Pollutant	Period	Highest	µg/m³	mon/day/hr	µg/m³	mon/day/hr	µg/m³	mon/day/hr	µg/m³	mon/day/hr	µg/m³	mon/day/hr
CO	1 hr	1st High	3824.4	09/15/22	3708.4	08/16/05	3574.2	12/08/22	3393.5	06/05/04	3640.6	06/02/02
		2nd High	3486.5	10/12/23	2741.4	09/18/05	3149.4	08/19/02	3026.0	05/23/04	3585.1	11/09/22
	8 hr	1st High	1109.0	09/15/24	822.3	10/17/08	774.7	10/25/08	603.3	04/13/08	930.7	11/22/08
		2nd High	830.6	09/06/08	731.3	08/11/24	718.4	10/24/08	559.4	09/30/24	893.3	11/09/24
NOx	Annual	-	7.55	-	8.1	-	7.58	-	10.4	-	7.96	-
	1 hr	1st High	435.6	10/01/16	486.8	05/08/12	310.9	06/21/11	612.3	06/12/10	319.3	03/27/15
		2nd High	302.1	06/17/12	444.5	02/22/02	310.3	08/12/11	457.2	02/12/19	314.3	11/01/14
PM10	Annual	-	3.65	-	3.85	-	3.75	-	4.36	-	3.67	-
	24 hr	1st High	30.1	07/18/24	41.6	11/25/24	35.3	10/25/24	36.0	04/13/24	35.8	08/26/24
		2nd High	24.1	05/29/24	32.4	09/30/24	34.7	10/24/24	24.8	01/15/24	29.1	09/06/24
Lead	24-hr	1st High	0.018	06/17/24	0.012	03/11/24	0.013	10/22/24	0.023	08/09/24	0.014	09/21/24
SO2	Annual	-	3.85	-	4.22	-	4.15	-	5.27	-	4.14	-
	3 hr	1st High	260.0	05/05/12	244.9	08/06/15	248.3	06/21/12	309.9	08/09/12	254.8	05/12/12
		2nd High	232.0	05/07/12	180.3	07/02/12	236.7	08/12/12	256.9	07/02/12	228.9	07/15/12
	24 hr	1st High	68.5	06/17/24	46.2	03/11/24	50.9	10/22/24	83.2	08/09/24	55.5	09/21/24
		2nd High	34.9	10/05/24	36.8	08/15/24	40.0	09/19/24	44.0	07/02/24	53.8	03/22/24

APPENDIX C

FACILITY SPECIFIC ASSESSMENTS FOR NON-CRITERIA POLLUTANTS

Type of model run: Facility-specific

Facility Information
ID Number: 097125ABA
Name: Abbott Labs - S-32 Carbon Bed
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 7.62 m
Stack Diameter: 0.661 m
Stack Exit Gas Velocity: 5.49 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 6123 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Di-(2-ethylhexyl) phthalate	0.00e+00 lbs/yr	1.00e+01 lbs/yr
Methanol	1.66e+03 lbs/yr	4.99e+02 lbs/yr
Methylene chloride	1.00e+05 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Di-(2-ethylhexyl) phthalate	0.00e+00	8.22e-07	-	-
Methanol	1.36e-04	4.10e-05	2.80e+01	-
Methylene chloride	8.20e-03	0.00e+00	1.40e+01	1.04e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Di-(2-ethylhexyl) phthalate	0.00e+00	7.00e-02	0.00e+00
Methanol	1.09e-05	1.75e+00	2.76e-07
Methylene chloride	6.56e-04	3.00e+00	9.69e-06
	Hazard Index (HI)		9.96e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Di-(2-ethylhexyl) phthalate	6.57e-08	7.00e-02	4.16e-08
Methanol	3.28e-06	1.75e+00	8.31e-08
Methylene chloride	0.00e+00	3.00e+00	0.00e+00
	Hazard Index (HI)		1.25e-07

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Di-(2-ethylhexyl) phthalate	6.57e-08	7.00e-02	4.16e-08
Methanol	1.42e-05	1.75e+00	3.59e-07
Methylene chloride	6.56e-04	3.00e+00	9.69e-06
	Hazard Index (HI)		1.01e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Di-(2-ethylhexyl) phthalate	0.00e+00	4.00e-03	0.00e+00
Methylene chloride	6.56e-04	4.70e-04	1.95e-09
	Total Risk		1.95e-09

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Di-(2-ethylhexyl) phthalate	6.57e-08	4.00e-03	1.66e-12
Methylene chloride	0.00e+00	4.70e-04	0.00e+00
	Total Risk		1.66e-12

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Di-(2-ethylhexyl) phthalate	6.57e-08	4.00e-03	1.66e-12
Methylene chloride	6.56e-04	4.70e-04	1.95e-09
	Total Risk		1.95e-09

Type of model run: Facility-specific

Facility Information
ID Number: 097125AAA
Name: Abbott Labs - Boiler 7
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 30.8 m Stack Diameter: 1.68 m
Stack Exit Gas Velocity: 9.62 m/sec Stack Exit Temperature: 450 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 6123 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Hydrochloric acid	3.20e+04 lbs/yr	0.00e+00 lbs/yr
Mercury Compounds	1.50e+01 lbs/yr	0.00e+00 lbs/yr
2,3,7,8-TCDD Equivalent	1.20e-05 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Hydrochloric acid	1.55e-03	0.00e+00	2.10e+00	-
Mercury Compounds	7.28e-07	0.00e+00	1.80e-03	-
2,3,7,8-TCDD Equivalent	5.82e-13	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Hydrochloric acid	1.24e-04	2.00e-02	2.75e-04
Mercury Compounds	5.82e-08	3.00e-04	8.60e-06
	Hazard Index (HI)		2.84e-04

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Hydrochloric acid	0.00e+00	2.00e-02	0.00e+00
Mercury Compounds	0.00e+00	3.00e-04	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Hydrochloric acid	1.24e-04	2.00e-02	2.75e-04
Mercury Compounds	5.82e-08	3.00e-04	8.60e-06
	Hazard Index (HI)		2.84e-04

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
2,3,7,8-TCDD Equivalent	4.66e-14	4.30e+04	1.27e-11
	Total Risk		1.27e-11

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
2,3,7,8-TCDD Equivalent	0.00e+00	4.30e+04	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
2,3,7,8-TCDD Equivalent	4.66e-14	4.30e+04	1.27e-11
	Total Risk		1.27e-11

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AET
Name: Avery-Dennison Commerical Products
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 12.5 m
Stack Diameter: 0.0914 m
Stack Exit Gas Velocity: 14.4 m/sec
Stack Exit Temperature: 300 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 5960 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Methylene chloride	2.48e+02 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Methylene chloride	1.96e-05	0.00e+00	1.40e+01	1.04e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methylene chloride	1.57e-06	3.00e+00	2.32e-08
	Hazard Index (HI)		2.32e-08

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methylene chloride	0.00e+00	3.00e+00	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methylene chloride	1.57e-06	3.00e+00	2.32e-08
	Hazard Index (HI)		2.32e-08

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	1.57e-06	4.70e-04	4.67e-12
	Total Risk		4.67e-12

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	0.00e+00	4.70e-04	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	1.57e-06	4.70e-04	4.67e-12
	Total Risk		4.67e-12

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097035AAQ
Name: BASF/ PPG Industries
Street Address:
City: Gurnee State: IL

For Stack Emissions
Stack Height: 5.64 m
Stack Diameter: 0.485 m
Stack Exit Gas Velocity: 3.94 m/sec
Stack Exit Temperature: 337 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 5974 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ethylene oxide	1.44e+02 lbs/yr	1.01e+03 lbs/yr
Propylene oxide	5.50e+01 lbs/yr	1.75e+02 lbs/yr
Methanol	2.70e+01 lbs/yr	1.50e+01 lbs/yr
Cresol (mixed isomers)	1.40e+01 lbs/yr	8.62e+02 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ethylene oxide	1.21e-05	8.54e-05	-	-
Propylene oxide	4.61e-06	1.48e-05	3.10e+00	-
Methanol	2.26e-06	1.27e-06	2.80e+01	-
Cresol (mixed isomers)	1.17e-06	7.29e-05	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Propylene oxide	3.69e-07	3.00e-02	5.45e-07
Methanol	1.81e-07	1.75e+00	4.59e-09
Cresol (mixed isomers)	9.39e-08	1.75e-01	2.38e-08
	Hazard Index (HI)		5.74e-07

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Propylene oxide	1.18e-06	3.00e-02	1.75e-06
Methanol	1.02e-07	1.75e+00	2.57e-09
Cresol (mixed isomers)	5.83e-06	1.75e-01	1.48e-06
	Hazard Index (HI)		3.23e-06

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Propylene oxide	1.55e-06	3.00e-02	2.29e-06
Methanol	2.83e-07	1.75e+00	7.16e-09
Cresol (mixed isomers)	5.93e-06	1.75e-01	1.50e-06
	Hazard Index (HI)		3.80e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	9.66e-07	1.00e-01	6.11e-10
Propylene oxide	3.69e-07	3.70e-03	8.65e-12
	Total Risk		6.20e-10

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	6.84e-06	1.00e-01	4.33e-09
Propylene oxide	1.18e-06	3.70e-03	2.77e-11
	Total Risk		4.36e-09

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	7.80e-06	1.00e-01	4.94e-09
Propylene oxide	1.55e-06	3.70e-03	3.64e-11
	Total Risk		4.98e-09

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190ADF
Name: Cherry Electrical Products
Street Address:
City: Waukegan State: IL

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 1453 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Toluene	0.00e+00 lbs/yr	5.27e+03 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Toluene	0.00e+00	2.88e-03	3.70e+01	1.51e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Toluene	0.00e+00	4.00e-01	0.00e+00
	Hazard Index (HI)		0.00e+00

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Toluene	2.30e-04	4.00e-01	2.55e-05
	Hazard Index (HI)		2.55e-05

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Toluene	2.30e-04	4.00e-01	2.55e-05
	Hazard Index (HI)		2.55e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190ACO
Name: Coral Chemical Company
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 6079 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Hydrofluoric acid	4.99e+02 lbs/yr	4.99e+02 lbs/yr
Glycol ethers	4.99e+02 lbs/yr	4.99e+02 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Hydrofluoric acid	4.13e-05	4.13e-05	2.40e-01	-
Glycol ethers	4.13e-05	4.13e-05	9.30e-02	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Glycol ethers	3.31e-06	2.00e-02	7.33e-06
	Hazard Index (HI)		7.33e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Glycol ethers	3.31e-06	2.00e-02	7.33e-06
	Hazard Index (HI)		7.33e-06

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Glycol ethers	6.62e-06	2.00e-02	1.47e-05
	Hazard Index (HI)		1.47e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AFG
Name: Cosmed of Illinois
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 8027 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ethylene oxide	3.30e+03 lbs/yr	1.80e+03 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ethylene oxide	1.97e-04	1.08e-04	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	1.58e-05	1.00e-01	1.00e-08
	Total Risk		1.00e-08

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	8.61e-06	1.00e-01	5.45e-09
	Total Risk		5.45e-09

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	2.44e-05	1.00e-01	1.54e-08
	Total Risk		1.54e-08

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number:
Name: Dexter Stack 1
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 15.24 m
Stack Diameter: 0.2 m
Stack Exit Gas Velocity: 26.84 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 3114.1 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Resident
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Chromium (Cr+6)	3.74e-06 g/sec	0.00e+00 lbs/day

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Chromium (Cr+6)	4.27e-08	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Resident

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	3.42e-09	8.00e-06	1.89e-05
	Hazard Index (HI)		1.89e-05

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	0.00e+00	8.00e-06	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	3.42e-09	8.00e-06	1.89e-05
	Hazard Index (HI)		1.89e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	3.42e-09	1.20e+01	2.60e-10
	Total Risk		2.60e-10

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	0.00e+00	1.20e+01	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	3.42e-09	1.20e+01	2.60e-10
	Total Risk		2.60e-10

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number:
Name: Dexter Stack 2
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 10.67 m Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 3114.1 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Resident
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Chromium (Cr+6)	2.10e-05 g/sec	0.00e+00 lbs/day

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Chromium (Cr+6)	2.73e-07	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Resident

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	2.18e-08	8.00e-06	1.21e-04
	Hazard Index (HI)		1.21e-04

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	0.00e+00	8.00e-06	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium (Cr+6)	2.18e-08	8.00e-06	1.21e-04
	Hazard Index (HI)		1.21e-04

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	2.18e-08	1.20e+01	1.66e-09
	Total Risk		1.66e-09

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	0.00e+00	1.20e+01	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium (Cr+6)	2.18e-08	1.20e+01	1.66e-09
	Total Risk		1.66e-09

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AAE
Name: Dexter Corporation
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 7.62 m
Stack Diameter: 0.155 m
Stack Exit Gas Velocity: 3.35 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 3546 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ethylbenzene	4.10e+01 lbs/yr	2.50e+01 lbs/yr
Methyl isobutyl ketone	9.96e+02 lbs/yr	9.59e+02 lbs/yr
Toluene	5.35e+03 lbs/yr	5.16e+03 lbs/yr
Phenol	8.00e+00 lbs/yr	1.00e+00 lbs/yr
Xylene (mixed isomers)	5.58e+03 lbs/yr	5.46e+03 lbs/yr
Formaldehyde	4.00e+00 lbs/yr	2.70e+01 lbs/yr
N,N-Dimethylformamide	7.36e+02 lbs/yr	7.36e+02 lbs/yr
Butyl alcohol	3.13e+03 lbs/yr	3.05e+03 lbs/yr
Methyl ethyl ketone	7.68e+03 lbs/yr	7.36e+03 lbs/yr
4,4'-Isopropylidenediphenol	8.46e+02 lbs/yr	9.40e+01 lbs/yr
N-Methyl-2-pyrrolidone	4.58e+02 lbs/yr	4.50e+02 lbs/yr
Glycol ethers	5.64e+03 lbs/yr	5.53e+03 lbs/yr
Diisocyanates	5.11e+02 lbs/yr	0.00e+00 lbs/yr
Barium compounds	2.99e+02 lbs/yr	0.00e+00 lbs/yr
Zinc compounds	1.42e+02 lbs/yr	0.00e+00 lbs/yr
Chromium compounds	0.00e+00 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ethylbenzene	6.62e-06	4.03e-06	-	-
Methyl isobutyl ketone	1.61e-04	1.55e-04	-	-
Toluene	8.63e-04	8.32e-04	3.70e+01	1.51e+01
Phenol	1.29e-06	1.61e-07	5.80e+00	-
Xylene (mixed isomers)	9.00e-04	8.80e-04	2.20e+01	4.30e+00
Formaldehyde	6.45e-07	4.35e-06	9.40e-02	4.90e-02
N,N-Dimethylformamide	1.19e-04	1.19e-04	-	-
Butyl alcohol	5.05e-04	4.92e-04	-	-
Methyl ethyl ketone	1.24e-03	1.19e-03	1.30e+01	-
4,4'-Isopropylidenediphenol	1.36e-04	1.52e-05	-	-
N-Methyl-2-pyrrolidone	7.39e-05	7.26e-05	-	-
Glycol ethers	9.10e-04	8.92e-04	9.30e-02	-
Diisocyanates	8.24e-05	0.00e+00	-	-
Barium compounds	4.82e-05	0.00e+00	-	-
Zinc compounds	2.29e-05	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ethylbenzene	5.29e-07	1.00e+00	2.35e-08
Methyl isobutyl ketone	1.29e-05	8.00e-02	7.12e-06
Toluene	6.91e-05	4.00e-01	7.65e-06
Phenol	1.03e-07	2.10e+00	2.18e-09
Xylene (mixed isomers)	7.20e-05	7.00e+00	4.56e-07
N,N-Dimethylformamide	9.50e-06	3.00e-02	1.40e-05
Butyl alcohol	4.04e-05	3.50e-01	5.12e-06
Methyl ethyl ketone	9.91e-05	1.00e+00	4.39e-06
4,4' -Isopropylidenediphenol	1.09e-05	1.75e-01	2.77e-06
Glycol ethers	7.28e-05	2.00e-02	1.61e-04
Diisocyanates	6.60e-06	1.00e-05	2.92e-02
Barium compounds	3.86e-06	4.90e-04	3.49e-04
Zinc compounds	1.83e-06	1.05e+00	7.74e-08
	Hazard Index (HI)		2.98e-02

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ethylbenzene	3.22e-07	1.00e+00	1.43e-08
Methyl isobutyl ketone	1.24e-05	8.00e-02	6.85e-06
Toluene	6.66e-05	4.00e-01	7.38e-06
Phenol	1.29e-08	2.10e+00	2.72e-10
Xylene (mixed isomers)	7.04e-05	7.00e+00	4.46e-07
N,N-Dimethylformamide	9.50e-06	3.00e-02	1.40e-05
Butyl alcohol	3.93e-05	3.50e-01	4.98e-06
Methyl ethyl ketone	9.50e-05	1.00e+00	4.21e-06
4,4' -Isopropylidenediphenol	1.21e-06	1.75e-01	3.07e-07
Glycol ethers	7.13e-05	2.00e-02	1.58e-04
Diisocyanates	0.00e+00	1.00e-05	0.00e+00
Barium compounds	0.00e+00	4.90e-04	0.00e+00
Zinc compounds	0.00e+00	1.05e+00	0.00e+00
	Hazard Index (HI)		1.96e-04

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ethylbenzene	8.52e-07	1.00e+00	3.78e-08
Methyl isobutyl ketone	2.52e-05	8.00e-02	1.40e-05
Toluene	1.36e-04	4.00e-01	1.50e-05
Phenol	1.16e-07	2.10e+00	2.45e-09
Xylene (mixed isomers)	1.42e-04	7.00e+00	9.02e-07
N,N-Dimethylformamide	1.90e-05	3.00e-02	2.81e-05
Butyl alcohol	7.97e-05	3.50e-01	1.01e-05
Methyl ethyl ketone	1.94e-04	1.00e+00	8.60e-06
4,4' -Isopropylidenediphenol	1.21e-05	1.75e-01	3.07e-06
Glycol ethers	1.44e-04	2.00e-02	3.19e-04
Diisocyanates	6.60e-06	1.00e-05	2.92e-02
Barium compounds	3.86e-06	4.90e-04	3.49e-04
Zinc compounds	1.83e-06	1.05e+00	7.74e-08

Hazard Index (HI)	3.00e-02

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	5.16e-08	1.30e-02	4.25e-12
	Total Risk		4.25e-12

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	3.48e-07	1.30e-02	2.87e-11
	Total Risk		2.87e-11

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	4.00e-07	1.30e-02	3.29e-11
	Total Risk		3.29e-11

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097035ABM
Name: Domino Amjet Inc.
Street Address:
City: Gurnee State: IL

For Stack Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 7166 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Methyl ethyl ketone	5.25e+03 lbs/yr	0.00e+00 lbs/yr
Methanol	2.62e+03 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Methyl ethyl ketone	3.58e-04	0.00e+00	1.30e+01	-
Methanol	1.79e-04	0.00e+00	2.80e+01	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methyl ethyl ketone	2.87e-05	1.00e+00	1.27e-06
Methanol	1.43e-05	1.75e+00	3.63e-07
	Hazard Index (HI)		1.63e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methyl ethyl ketone	0.00e+00	1.00e+00	0.00e+00
Methanol	0.00e+00	1.75e+00	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methyl ethyl ketone	2.87e-05	1.00e+00	1.27e-06
Methanol	1.43e-05	1.75e+00	3.63e-07
	Hazard Index (HI)		1.63e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit

risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097125ABI
Name: Emco Chemicals
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 5.49 m Stack Diameter: 0.538 m
Stack Exit Gas Velocity: 7.22 m/sec Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 7978 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Butyl alcohol	5.80e+01 lbs/yr	1.10e+01 lbs/yr
Dibutyl phthalate	0.00e+00 lbs/yr	2.70e+01 lbs/yr
Methylene chloride	3.33e+03 lbs/yr	1.34e+03 lbs/yr
Ethylbenzene	1.60e+01 lbs/yr	5.60e+01 lbs/yr
Glycol ethers	0.00e+00 lbs/yr	3.60e+01 lbs/yr
Hexane	4.28e+02 lbs/yr	8.00e+01 lbs/yr
Hydrochloric acid	0.00e+00 lbs/yr	4.00e+00 lbs/yr
Isopopyl alcohol	4.43e+02 lbs/yr	2.91e+02 lbs/yr
Methanol	2.27e+02 lbs/yr	2.26e+02 lbs/yr
Methyl ethyl ketone	7.81e+02 lbs/yr	3.93e+02 lbs/yr
Methyl isobutyl ketone	9.00e+01 lbs/yr	1.69e+02 lbs/yr
Naphthalene	2.00e+00 lbs/yr	2.10e+01 lbs/yr
Tetrachloroethylene	0.00e+00 lbs/yr	1.40e+01 lbs/yr
Trichloroethylene	1.95e+02 lbs/yr	1.55e+02 lbs/yr
1,2,4-Trimethylbenzene	1.90e+01 lbs/yr	4.60e+01 lbs/yr
Toluene	4.71e+02 lbs/yr	4.82e+02 lbs/yr
Xylene (mixed isomers)	1.07e+02 lbs/yr	3.74e+02 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Butyl alcohol	3.49e-06	6.62e-07	-	-
Dibutyl phthalate	0.00e+00	1.63e-06	-	-
Methylene chloride	2.00e-04	8.10e-05	1.40e+01	1.04e+01
Ethylbenzene	9.63e-07	3.37e-06	-	-
Glycol ethers	0.00e+00	2.17e-06	9.30e-02	-
Hexane	2.58e-05	4.82e-06	-	-
Hydrochloric acid	0.00e+00	2.41e-07	2.10e+00	-
Isopopyl alcohol	2.66e-05	1.75e-05	3.20e+00	-
Methanol	1.37e-05	1.36e-05	2.80e+01	-
Methyl ethyl ketone	4.70e-05	2.37e-05	1.30e+01	-
Methyl isobutyl ketone	5.41e-06	1.02e-05	-	-
Naphthalene	1.20e-07	1.27e-06	-	-
Tetrachloroethylene	0.00e+00	8.43e-07	2.00e+01	1.36e+00
Trichloroethylene	1.17e-05	9.33e-06	-	1.07e+01
1,2,4-Trimethylbenzene	1.14e-06	2.77e-06	-	-
Toluene	2.83e-05	2.90e-05	3.70e+01	1.51e+01
Xylene (mixed isomers)	6.44e-06	2.25e-05	2.20e+01	4.30e+00

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Butyl alcohol	2.79e-07	3.50e-01	3.54e-08
Dibutyl phthalate	0.00e+00	3.50e-01	0.00e+00
Methylene chloride	1.60e-05	3.00e+00	2.37e-07
Ethylbenzene	7.70e-08	1.00e+00	3.41e-09
Glycol ethers	0.00e+00	2.00e-02	0.00e+00
Hexane	2.06e-06	2.00e-01	4.57e-07
Hydrochloric acid	0.00e+00	2.00e-02	0.00e+00
Methanol	1.09e-06	1.75e+00	2.77e-08
Methyl ethyl ketone	3.76e-06	1.00e+00	1.67e-07
Methyl isobutyl ketone	4.33e-07	8.00e-02	2.40e-07
Naphthalene	9.62e-09	3.00e-03	1.42e-07
Tetrachloroethylene	0.00e+00	3.50e-02	0.00e+00
1,2,4-Trimethylbenzene	9.14e-08	5.95e-03	6.81e-07
Toluene	2.27e-06	4.00e-01	2.51e-07
Xylene (mixed isomers)	5.15e-07	7.00e+00	3.26e-09
	Hazard Index (HI)		2.24e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Butyl alcohol	5.30e-08	3.50e-01	6.71e-09
Dibutyl phthalate	1.30e-07	3.50e-01	1.65e-08
Methylene chloride	6.48e-06	3.00e+00	9.57e-08
Ethylbenzene	2.70e-07	1.00e+00	1.20e-08
Glycol ethers	1.73e-07	2.00e-02	3.84e-07
Hexane	3.85e-07	2.00e-01	8.54e-08
Hydrochloric acid	1.93e-08	2.00e-02	4.27e-08
Methanol	1.09e-06	1.75e+00	2.76e-08
Methyl ethyl ketone	1.89e-06	1.00e+00	8.39e-08
Methyl isobutyl ketone	8.14e-07	8.00e-02	4.51e-07
Naphthalene	1.01e-07	3.00e-03	1.50e-06
Tetrachloroethylene	6.74e-08	3.50e-02	8.54e-08
1,2,4-Trimethylbenzene	2.22e-07	5.95e-03	1.65e-06
Toluene	2.32e-06	4.00e-01	2.57e-07
Xylene (mixed isomers)	1.80e-06	7.00e+00	1.14e-08
	Hazard Index (HI)		4.71e-06

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Butyl alcohol	3.32e-07	3.50e-01	4.21e-08
Dibutyl phthalate	1.30e-07	3.50e-01	1.65e-08
Methylene chloride	2.25e-05	3.00e+00	3.33e-07
Ethylbenzene	3.47e-07	1.00e+00	1.54e-08
Glycol ethers	1.73e-07	2.00e-02	3.84e-07
Hexane	2.45e-06	2.00e-01	5.42e-07
Hydrochloric acid	1.93e-08	2.00e-02	4.27e-08
Methanol	2.18e-06	1.75e+00	5.53e-08
Methyl ethyl ketone	5.65e-06	1.00e+00	2.51e-07
Methyl isobutyl ketone	1.25e-06	8.00e-02	6.91e-07
Naphthalene	1.11e-07	3.00e-03	1.64e-06
Tetrachloroethylene	6.74e-08	3.50e-02	8.54e-08
1,2,4-Trimethylbenzene	3.13e-07	5.95e-03	2.33e-06
Toluene	4.59e-06	4.00e-01	5.08e-07
Xylene (mixed isomers)	2.32e-06	7.00e+00	1.47e-08
	Hazard Index (HI)		6.95e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	1.60e-05	4.70e-04	4.77e-11
Tetrachloroethylene	0.00e+00	5.71e-04	0.00e+00
Trichloroethylene	9.38e-07	1.71e-03	1.02e-11
	Total Risk		5.79e-11

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	6.48e-06	4.70e-04	1.93e-11
Tetrachloroethylene	6.74e-08	5.71e-04	2.44e-13
Trichloroethylene	7.47e-07	1.71e-03	8.09e-12
	Total Risk		2.76e-11

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Methylene chloride	2.25e-05	4.70e-04	6.70e-11
Tetrachloroethylene	6.74e-08	5.71e-04	2.44e-13
Trichloroethylene	1.69e-06	1.71e-03	1.82e-11
	Total Risk		8.55e-11

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097125AAD
Name: Fansteel, Inc. (Federal Die Casting Co.)
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 7.92 m Stack Diameter: 0.762 m
Stack Exit Gas Velocity: 4.42 m/sec Stack Exit Temperature: 428 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 7439 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Aluminum	8.45e+03 lbs/yr	9.39e+02 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Aluminum	5.38e-04	6.13e-05	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Aluminum	4.30e-05	3.50e-03	5.45e-04
	Hazard Index (HI)		5.45e-04

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Aluminum	4.91e-06	3.50e-03	6.21e-05
	Hazard Index (HI)		6.21e-05

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Aluminum	4.79e-05	3.50e-03	6.07e-04
	Hazard Index (HI)		6.07e-04

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit

risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097035AAP
Name: Gallagher Corporation
Street Address:
City: Gurnee State: IL

For Stack Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 7153 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Formaldehyde	2.40e-01 lbs/yr	0.00e+00 lbs/yr
4,4-Methylene diphenyl diisocyanate	1.80e-02 lbs/yr	0.00e+00 lbs/yr
Phenol	8.20e+01 lbs/yr	0.00e+00 lbs/yr
Trichloroethylene	3.30e+03 lbs/yr	0.00e+00 lbs/yr
Toluene	4.82e+03 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Formaldehyde	1.64e-08	0.00e+00	9.40e-02	4.90e-02
4,4-Methylene diphenyl diisocyanate	1.23e-09	0.00e+00	-	-
Phenol	5.61e-06	0.00e+00	5.80e+00	-
Trichloroethylene	2.26e-04	0.00e+00	-	1.07e+01
Toluene	3.30e-04	0.00e+00	3.70e+01	1.51e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
4,4-Methylene diphenyl diisocyanate	9.85e-11	6.00e-04	7.28e-09
Phenol	4.49e-07	2.10e+00	9.47e-09
Toluene	2.64e-05	4.00e-01	2.92e-06
	Hazard Index (HI)		2.94e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
4,4-Methylene diphenyl diisocyanate	0.00e+00	6.00e-04	0.00e+00
Phenol	0.00e+00	2.10e+00	0.00e+00
Toluene	0.00e+00	4.00e-01	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
4,4-Methylene diphenyl diisocyanate	9.85e-11	6.00e-04	7.28e-09
Phenol	4.49e-07	2.10e+00	9.47e-09
Toluene	2.64e-05	4.00e-01	2.92e-06
	Hazard Index (HI)		2.94e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	1.31e-09	1.30e-02	1.08e-13
Trichloroethylene	1.80e-05	1.70e-03	1.94e-10
	Total Risk		1.94e-10

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	0.00e+00	1.30e-02	0.00e+00
Trichloroethylene	0.00e+00	1.70e-03	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Formaldehyde	1.31e-09	1.30e-02	1.08e-13
Trichloroethylene	1.80e-05	1.70e-03	1.94e-10
	Total Risk		1.94e-10

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097125AAM
Name: Gillette Co.
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 8.05 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/sec
Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 8213 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ammonia	2.70e+02 lbs/yr	2.50e+01 lbs/yr
Hydrochloric acid	1.50e+03 lbs/yr	1.00e+01 lbs/yr
Methanol	1.20e+04 lbs/yr	1.00e+01 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ammonia	1.57e-05	1.46e-06	3.20e+00	3.50e-01
Hydrochloric acid	8.74e-05	5.82e-07	2.10e+00	-
Methanol	6.99e-04	5.82e-07	2.80e+01	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ammonia	1.26e-06	1.00e-01	5.58e-07
Hydrochloric acid	6.99e-06	2.00e-02	1.55e-05
Methanol	5.59e-05	1.75e+00	1.42e-06
	Hazard Index (HI)		1.75e-05

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ammonia	1.16e-07	1.00e-01	5.16e-08
Hydrochloric acid	4.66e-08	2.00e-02	1.03e-07
Methanol	4.66e-08	1.75e+00	1.18e-09
	Hazard Index (HI)		1.56e-07

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Ammonia	1.37e-06	1.00e-01	6.09e-07
Hydrochloric acid	7.04e-06	2.00e-02	1.56e-05
Methanol	5.60e-05	1.75e+00	1.42e-06
	Hazard Index (HI)		1.76e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097125AAG
Name: R. Lavin & Sons, Inc.
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 13.5 m
Stack Diameter: 2.08 m
Stack Exit Gas Velocity: 2.9 m/sec
Stack Exit Temperature: 507 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 6960 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Zinc compounds	2.60e+04 lbs/yr	1.60e+04 lbs/yr
Copper	4.30e+02 lbs/yr	2.40e+02 lbs/yr
Lead	3.00e+03 lbs/yr	1.80e+03 lbs/yr
Manganese	5.00e+00 lbs/yr	3.00e+00 lbs/yr
Nickel	5.00e+00 lbs/yr	3.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Zinc compounds	1.53e-03	1.13e-03	-	-
Copper	2.53e-05	1.69e-05	1.00e-01	-
Lead	1.76e-04	1.27e-04	-	-
Manganese	2.94e-07	2.12e-07	-	-
Nickel	2.94e-07	2.12e-07	6.00e-03	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Zinc compounds	1.22e-04	1.05e+00	5.16e-06
Copper	2.02e-06	1.40e-01	6.41e-07
Manganese	2.35e-08	5.00e-05	2.09e-05
Nickel	2.35e-08	7.00e-02	1.49e-08
	Hazard Index (HI)		2.67e-05

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Zinc compounds	9.04e-05	1.05e+00	3.82e-06
Copper	1.36e-06	1.40e-01	4.29e-07
Manganese	1.69e-08	5.00e-05	1.50e-05
Nickel	1.69e-08	7.00e-02	1.07e-08
	Hazard Index (HI)		1.93e-05

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Zinc compounds	2.13e-04	1.05e+00	8.98e-06
Copper	3.38e-06	1.40e-01	1.07e-06
Manganese	4.05e-08	5.00e-05	3.59e-05
Nickel	4.05e-08	7.00e-02	2.56e-08
	Hazard Index (HI)		4.60e-05

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AAC
Name: Midwest Generation
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 97.6 m
Stack Diameter: 3.86 m
Stack Exit Gas Velocity: 25.4 m/sec
Stack Exit Temperature: 481 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 767 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Chromium compounds	3.60e+02 lbs/yr	0.00e+00 lbs/yr
Copper compounds	3.80e+02 lbs/yr	0.00e+00 lbs/yr
Sulfuric acid	4.50e+04 lbs/yr	0.00e+00 lbs/yr
Hydrochloric acid	2.15e+05 lbs/yr	0.00e+00 lbs/yr
Hydrofluoric acid	3.00e+05 lbs/yr	0.00e+00 lbs/yr
Lead	2.73e+04 lbs/yr	0.00e+00 lbs/yr
Manganese compounds	1.11e+03 lbs/yr	0.00e+00 lbs/yr
Nickel compounds	4.70e+02 lbs/yr	0.00e+00 lbs/yr
2,3,7,8-TCDD Equivalent	1.30e-03 lbs/yr	0.00e+00 lbs/yr
Mercury (elemental, inorganic)	6.29e+02 lbs/yr	0.00e+00 lbs/yr
PACs (Benzo(a)pyrene)	9.20e+00 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Chromium compounds	2.41e-06	0.00e+00	-	-
Copper compounds	2.54e-06	0.00e+00	1.00e-01	-
Sulfuric acid	3.01e-04	0.00e+00	1.20e-01	-
Hydrochloric acid	1.44e-03	0.00e+00	2.10e+00	-
Hydrofluoric acid	2.00e-03	0.00e+00	2.40e-01	-
Lead	1.82e-04	0.00e+00	-	-
Manganese compounds	7.42e-06	0.00e+00	-	-
Nickel compounds	3.14e-06	0.00e+00	6.00e-03	-
2,3,7,8-TCDD Equivalent	8.69e-12	0.00e+00	-	-
Mercury (elemental, inorganic)	4.21e-06	0.00e+00	1.80e-03	-
PACs (Benzo(a)pyrene)	6.15e-08	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium compounds	1.92e-07	8.00e-06	1.07e-03
Copper compounds	2.03e-07	1.40e-01	6.43e-08
Hydrochloric acid	1.15e-04	2.00e-02	2.55e-04
Manganese compounds	5.93e-07	5.00e-05	5.26e-04
Nickel compounds	2.51e-07	7.00e-02	1.59e-07
Mercury (elemental, inorganic)	3.36e-07	3.00e-04	4.97e-05
	Hazard Index (HI)		1.90e-03

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium compounds	0.00e+00	8.00e-06	0.00e+00
Copper compounds	0.00e+00	1.40e-01	0.00e+00
Hydrochloric acid	0.00e+00	2.00e-02	0.00e+00
Manganese compounds	0.00e+00	5.00e-05	0.00e+00
Nickel compounds	0.00e+00	7.00e-02	0.00e+00

Mercury (elemental, inorganic)	0.00e+00	3.00e-04	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Chromium compounds	1.92e-07	8.00e-06	1.07e-03
Copper compounds	2.03e-07	1.40e-01	6.43e-08
Hydrochloric acid	1.15e-04	2.00e-02	2.55e-04
Manganese compounds	5.93e-07	5.00e-05	5.26e-04
Nickel compounds	2.51e-07	7.00e-02	1.59e-07
Mercury (elemental, inorganic)	3.36e-07	3.00e-04	4.97e-05
	Hazard Index (HI)		1.90e-03

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium compounds	1.92e-07	1.20e+01	1.46e-08
2,3,7,8-TCDD Equivalent	6.95e-13	4.30e+04	1.89e-10
PACs (Benzo(a)pyrene)	4.92e-09	2.10e+00	6.54e-11
	Total Risk		1.49e-08

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium compounds	0.00e+00	1.20e+01	0.00e+00
2,3,7,8-TCDD Equivalent	0.00e+00	4.30e+04	0.00e+00
PACs (Benzo(a)pyrene)	0.00e+00	2.10e+00	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Chromium compounds	1.92e-07	1.20e+01	1.46e-08
2,3,7,8-TCDD Equivalent	6.95e-13	4.30e+04	1.89e-10
PACs (Benzo(a)pyrene)	4.92e-09	2.10e+00	6.54e-11
	Total Risk		1.49e-08

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AAK
Name: Outboard Marine Corp. - Plant 1
Street Address:
City: Waukegan
State: IL

For Stack Emissions
Stack Height: 11.7 m
Stack Diameter: 0.479 m
Stack Exit Gas Velocity: 7.34 m/sec
Stack Exit Temperature: 360 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 2756 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
1,3-Butadiene	3.11e+03 lbs/yr	0.00e+00 lbs/yr
Propionaldehyde	6.61e+02 lbs/yr	0.00e+00 lbs/yr
Acetaldehyde	1.75e+03 lbs/yr	0.00e+00 lbs/yr
Acrolein	6.63e+02 lbs/yr	0.00e+00 lbs/yr
Benzene	1.00e+04 lbs/yr	0.00e+00 lbs/yr
Toluene	8.10e+04 lbs/yr	0.00e+00 lbs/yr
Chromium compounds	9.72e+01 lbs/yr	0.00e+00 lbs/yr
O-Xylene	3.40e+04 lbs/yr	0.00e+00 lbs/yr
P-Xylene	7.27e+01 lbs/yr	0.00e+00 lbs/yr
M & P Xylene	9.20e+04 lbs/yr	0.00e+00 lbs/yr
Xylene (mixed isomers)	7.97e+03 lbs/yr	0.00e+00 lbs/yr
Cumene	2.20e+03 lbs/yr	0.00e+00 lbs/yr
Ethylbenzene	3.96e+04 lbs/yr	0.00e+00 lbs/yr
Formaldehyde	9.57e+03 lbs/yr	0.00e+00 lbs/yr
Glycol ethers	1.99e+04 lbs/yr	0.00e+00 lbs/yr
Hexane	2.14e+04 lbs/yr	0.00e+00 lbs/yr
Methyl ethyl ketone	2.78e+04 lbs/yr	0.00e+00 lbs/yr
Methyl tert-butyl ether	2.05e+05 lbs/yr	0.00e+00 lbs/yr
Crotonaldehyde	8.76e-01 lbs/yr	0.00e+00 lbs/yr
2,2,4-Trimethylpentane	7.71e+01 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
1,3-Butadiene	6.28e-04	0.00e+00	-	-
Propionaldehyde	1.33e-04	0.00e+00	-	-
Acetaldehyde	3.53e-04	0.00e+00	-	-
Acrolein	1.34e-04	0.00e+00	1.90e-04	1.14e-04
Benzene	2.02e-03	0.00e+00	1.30e+00	1.59e-01
Toluene	1.64e-02	0.00e+00	3.70e+01	1.51e+01
Chromium compounds	1.96e-05	0.00e+00	-	-
O-Xylene	6.86e-03	0.00e+00	2.20e+01	4.30e+00
P-Xylene	1.47e-05	0.00e+00	2.20e+01	4.30e+00
M & P Xylene	1.86e-02	0.00e+00	2.20e+01	4.30e+00
Xylene (mixed isomers)	1.61e-03	0.00e+00	2.20e+01	4.30e+00
Cumene	4.44e-04	0.00e+00	-	-
Ethylbenzene	8.00e-03	0.00e+00	-	-
Formaldehyde	1.93e-03	0.00e+00	9.40e-02	4.90e-02
Glycol ethers	4.01e-03	0.00e+00	9.30e-02	-
Hexane	4.31e-03	0.00e+00	-	-
Methyl ethyl ketone	5.61e-03	0.00e+00	1.30e+01	-
Methyl tert-butyl ether	4.14e-02	0.00e+00	-	7.21e+00
Crotonaldehyde	1.77e-07	0.00e+00	-	-
2,2,4-Trimethylpentane	1.56e-05	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Acetaldehyde	2.83e-05	9.00e-03	1.39e-04
Acrolein	1.07e-05	2.00e-05	2.37e-02
Toluene	1.31e-03	4.00e-01	1.45e-04
Chromium compounds	1.57e-06	8.00e-06	8.70e-03
O-Xylene	5.49e-04	7.00e+00	3.47e-06
P-Xylene	1.17e-06	7.00e+00	7.43e-09
M & P Xylene	1.48e-03	7.00e+00	9.40e-06
Xylene (mixed isomers)	1.29e-04	7.00e+00	8.15e-07
Cumene	3.55e-05	4.00e-01	3.94e-06
Ethylbenzene	6.40e-04	1.00e+00	2.84e-05
Glycol ethers	3.21e-04	2.00e-02	7.12e-04
Hexane	3.45e-04	2.00e-01	7.64e-05
Methyl ethyl ketone	4.49e-04	1.00e+00	1.99e-05
Methyl tert-butyl ether	3.32e-03	3.00e+00	4.90e-05
	Hazard Index (HI)		3.36e-02

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Acetaldehyde	0.00e+00	9.00e-03	0.00e+00
Acrolein	0.00e+00	2.00e-05	0.00e+00
Toluene	0.00e+00	4.00e-01	0.00e+00
Chromium compounds	0.00e+00	8.00e-06	0.00e+00
O-Xylene	0.00e+00	7.00e+00	0.00e+00
P-Xylene	0.00e+00	7.00e+00	0.00e+00
M & P Xylene	0.00e+00	7.00e+00	0.00e+00
Xylene (mixed isomers)	0.00e+00	7.00e+00	0.00e+00
Cumene	0.00e+00	4.00e-01	0.00e+00
Ethylbenzene	0.00e+00	1.00e+00	0.00e+00
Glycol ethers	0.00e+00	2.00e-02	0.00e+00
Hexane	0.00e+00	2.00e-01	0.00e+00
Methyl ethyl ketone	0.00e+00	1.00e+00	0.00e+00
Methyl tert-butyl ether	0.00e+00	3.00e+00	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Acetaldehyde	2.83e-05	9.00e-03	1.39e-04
Acrolein	1.07e-05	2.00e-05	2.37e-02
Toluene	1.31e-03	4.00e-01	1.45e-04
Chromium compounds	1.57e-06	8.00e-06	8.70e-03
O-Xylene	5.49e-04	7.00e+00	3.47e-06
P-Xylene	1.17e-06	7.00e+00	7.43e-09
M & P Xylene	1.48e-03	7.00e+00	9.40e-06
Xylene (mixed isomers)	1.29e-04	7.00e+00	8.15e-07
Cumene	3.55e-05	4.00e-01	3.94e-06
Ethylbenzene	6.40e-04	1.00e+00	2.84e-05
Glycol ethers	3.21e-04	2.00e-02	7.12e-04
Hexane	3.45e-04	2.00e-01	7.64e-05
Methyl ethyl ketone	4.49e-04	1.00e+00	1.99e-05
Methyl tert-butyl ether	3.32e-03	3.00e+00	4.90e-05
	Hazard Index (HI)		3.36e-02

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
1,3-Butadiene	5.02e-05	2.80e-01	8.90e-08
Acetaldehyde	2.83e-05	2.20e-03	3.94e-10
Benzene	1.62e-04	2.20e-03	2.25e-09
Chromium compounds	1.57e-06	1.20e+01	1.19e-07
Formaldehyde	1.54e-04	1.30e-02	1.27e-08
Crotonaldehyde	1.41e-08	5.43e-01	4.86e-11
	Total Risk		2.24e-07

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
1,3-Butadiene	0.00e+00	2.80e-01	0.00e+00
Acetaldehyde	0.00e+00	2.20e-03	0.00e+00
Benzene	0.00e+00	2.20e-03	0.00e+00
Chromium compounds	0.00e+00	1.20e+01	0.00e+00
Formaldehyde	0.00e+00	1.30e-02	0.00e+00
Crotonaldehyde	0.00e+00	5.43e-01	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
1,3-Butadiene	5.02e-05	2.80e-01	8.90e-08
Acetaldehyde	2.83e-05	2.20e-03	3.94e-10
Benzene	1.62e-04	2.20e-03	2.25e-09
Chromium compounds	1.57e-06	1.20e+01	1.19e-07
Formaldehyde	1.54e-04	1.30e-02	1.27e-08
Crotonaldehyde	1.41e-08	5.43e-01	4.86e-11
	Total Risk		2.24e-07

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190ABK
Name: Outboard Marine Corp. - Plant 2
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 11.2 m Stack Diameter: 0.711 m
Stack Exit Gas Velocity: 13.8 m/sec Stack Exit Temperature: 294 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 2068 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Manganese	3.43e+02 lbs/yr	0.00e+00 lbs/yr
Chromium	1.64e+02 lbs/yr	0.00e+00 lbs/yr
Nickel	1.18e+02 lbs/yr	0.00e+00 lbs/yr
Glycol ethers	1.45e+04 lbs/yr	0.00e+00 lbs/yr
Xylene (mixed isomers)	2.58e+04 lbs/yr	0.00e+00 lbs/yr
Methyl ethyl ketone	7.24e+04 lbs/yr	0.00e+00 lbs/yr
Toluene	5.87e+03 lbs/yr	0.00e+00 lbs/yr
Dibutyl phthalate	1.88e+03 lbs/yr	0.00e+00 lbs/yr
Methyl isobutyl ketone	9.33e+03 lbs/yr	0.00e+00 lbs/yr
Ethylbenzene	1.88e+03 lbs/yr	0.00e+00 lbs/yr
Di-2-ethylhexyl phthalate	1.84e+03 lbs/yr	0.00e+00 lbs/yr
Methanol	1.66e+03 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S.

Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Manganese	1.06e-04	0.00e+00	-	-
Chromium	5.04e-05	0.00e+00	-	-
Nickel	3.63e-05	0.00e+00	6.00e-03	-
Glycol ethers	4.45e-03	0.00e+00	9.30e-02	-
Xylene (mixed isomers)	7.94e-03	0.00e+00	2.20e+01	4.30e+00
Methyl ethyl ketone	2.23e-02	0.00e+00	1.30e+01	-
Toluene	1.81e-03	0.00e+00	3.70e+01	1.51e+01
Dibutyl phthalate	5.80e-04	0.00e+00	-	-
Methyl isobutyl ketone	2.87e-03	0.00e+00	-	-
Ethylbenzene	5.80e-04	0.00e+00	-	-
Di-2-ethylhexyl phthalate	5.66e-04	0.00e+00	-	-
Methanol	5.12e-04	0.00e+00	2.80e+01	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Manganese	8.45e-06	5.00e-05	7.49e-03
Chromium	4.03e-06	8.00e-06	2.23e-02
Nickel	2.90e-06	7.00e-02	1.84e-06
Glycol ethers	3.56e-04	2.00e-02	7.89e-04
Xylene (mixed isomers)	6.35e-04	7.00e+00	4.02e-06
Methyl ethyl ketone	1.78e-03	1.00e+00	7.90e-05
Toluene	1.44e-04	4.00e-01	1.60e-05
Dibutyl phthalate	4.64e-05	3.50e-01	5.87e-06
Methyl isobutyl ketone	2.30e-04	8.00e-02	1.27e-04
Ethylbenzene	4.64e-05	1.00e+00	2.06e-06
Di-2-ethylhexyl phthalate	4.53e-05	7.00e-02	2.87e-05
Methanol	4.10e-05	1.75e+00	1.04e-06
	Hazard Index (HI)		3.09e-02

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Manganese	0.00e+00	5.00e-05	0.00e+00
Chromium	0.00e+00	8.00e-06	0.00e+00
Nickel	0.00e+00	7.00e-02	0.00e+00
Glycol ethers	0.00e+00	2.00e-02	0.00e+00
Xylene (mixed isomers)	0.00e+00	7.00e+00	0.00e+00
Methyl ethyl ketone	0.00e+00	1.00e+00	0.00e+00
Toluene	0.00e+00	4.00e-01	0.00e+00
Dibutyl phthalate	0.00e+00	3.50e-01	0.00e+00
Methyl isobutyl ketone	0.00e+00	8.00e-02	0.00e+00
Ethylbenzene	0.00e+00	1.00e+00	0.00e+00
Di-2-ethylhexyl phthalate	0.00e+00	7.00e-02	0.00e+00
Methanol	0.00e+00	1.75e+00	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Manganese	8.45e-06	5.00e-05	7.49e-03
Chromium	4.03e-06	8.00e-06	2.23e-02
Nickel	2.90e-06	7.00e-02	1.84e-06
Glycol ethers	3.56e-04	2.00e-02	7.89e-04
Xylene (mixed isomers)	6.35e-04	7.00e+00	4.02e-06
Methyl ethyl ketone	1.78e-03	1.00e+00	7.90e-05
Toluene	1.44e-04	4.00e-01	1.60e-05
Dibutyl phthalate	4.64e-05	3.50e-01	5.87e-06
Methyl isobutyl ketone	2.30e-04	8.00e-02	1.27e-04
Ethylbenzene	4.64e-05	1.00e+00	2.06e-06
Di-2-ethylhexyl phthalate	4.53e-05	7.00e-02	2.87e-05
Methanol	4.10e-05	1.75e+00	1.04e-06
	Hazard Index (HI)		3.09e-02

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit

risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium	4.03e-06	1.20e+01	3.06e-07
Di-2-ethylhexyl phthalate	4.53e-05	4.00e-03	1.15e-09
	Total Risk		3.07e-07

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium	0.00e+00	1.20e+01	0.00e+00
Di-2-ethylhexyl phthalate	0.00e+00	4.00e-03	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Chromium	4.03e-06	1.20e+01	3.06e-07
Di-2-ethylhexyl phthalate	4.53e-05	4.00e-03	1.15e-09
	Total Risk		3.07e-07

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190ACS
Name: Pfanstiehl Laboratories Inc.
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 9.41 m
Stack Diameter: 0.192 m
Stack Exit Gas Velocity: 1.69 m/sec
Stack Exit Temperature: 372 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 4528 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Methanol	6.48e+03 lbs/yr	0.00e+00 lbs/yr
Hexane	1.50e+03 lbs/yr	0.00e+00 lbs/yr
Acetonitrile	1.42e+02 lbs/yr	0.00e+00 lbs/yr
Toluene	9.60e+01 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Methanol	7.63e-04	0.00e+00	2.80e+01	-
Hexane	1.76e-04	0.00e+00	-	-
Acetonitrile	1.67e-05	0.00e+00	-	-
Toluene	1.13e-05	0.00e+00	3.70e+01	1.51e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methanol	6.11e-05	1.75e+00	1.55e-06
Hexane	1.41e-05	2.00e-01	3.13e-06
Acetonitrile	1.34e-06	6.00e-02	9.89e-07
Toluene	9.05e-07	4.00e-01	1.00e-07
	Hazard Index (HI)		5.77e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methanol	0.00e+00	1.75e+00	0.00e+00
Hexane	0.00e+00	2.00e-01	0.00e+00
Acetonitrile	0.00e+00	6.00e-02	0.00e+00
Toluene	0.00e+00	4.00e-01	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Methanol	6.11e-05	1.75e+00	1.55e-06
Hexane	1.41e-05	2.00e-01	3.13e-06
Acetonitrile	1.34e-06	6.00e-02	9.89e-07
Toluene	9.05e-07	4.00e-01	1.00e-07
	Hazard Index (HI)		5.77e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190AAW
Name: Provena Hospitals D/B/A St. Therese Med. Ctr.
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 11.8 m
Stack Diameter: 0.488 m
Stack Exit Gas Velocity: 5.99 m/sec
Stack Exit Temperature: 260 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 5168 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ethylene oxide	2.62e+02 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ethylene oxide	2.50e-05	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	2.00e-06	1.00e-01	1.27e-09
	Total Risk		1.27e-09

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	0.00e+00	1.00e-01	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	2.00e-06	1.00e-01	1.27e-09
	Total Risk		1.27e-09

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097035AAS
Name: Roqette America, Inc.
Street Address:
City: Gurnee State: IL

For Stack Emissions
Stack Height: 4.06 m
Stack Diameter: 0.681 m
Stack Exit Gas Velocity: 4.86 m/sec
Stack Exit Temperature: 369 K
Ambient Air Temperature: 294 K

For Fugitive Emissions
Stack Height: 10 m
Stack Diameter: 0.1 m
Stack Exit Gas Velocity: 0.1 m/s
Stack Exit Temperature: 294.26 K
Ambient Air Temperature: 294.26 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 8295 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Nickel	4.99e+02 lbs/yr	1.00e+01 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Nickel	2.84e-05	5.76e-07	6.00e-03	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Nickel	2.27e-06	7.00e-02	1.44e-06
	Hazard Index (HI)		1.44e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Nickel	4.61e-08	7.00e-02	2.92e-08
	Hazard Index (HI)		2.92e-08

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Nickel	2.31e-06	7.00e-02	1.47e-06
	Hazard Index (HI)		1.47e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit

risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)

Cancer Risks do not exist for the selected chemical(s).

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097125AAY
Name: Stone Container
Street Address:
City: North Chicago State: IL

For Stack Emissions
Stack Height: 10.5 m
Stack Diameter: 0.579 m
Stack Exit Gas Velocity: 4.21 m/sec
Stack Exit Temperature: 533 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 6927 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Receptor - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Vinyl acetate	1.22e+02 lbs/yr	0.00e+00 lbs/yr
Hydroquinone	1.00e+00 lbs/yr	0.00e+00 lbs/yr
Ethyl acrylate	6.00e-01 lbs/yr	0.00e+00 lbs/yr
Acetaldehyde	1.20e+01 lbs/yr	0.00e+00 lbs/yr
Formaldehyde	6.00e+01 lbs/yr	0.00e+00 lbs/yr
Glycol ethers	3.00e+02 lbs/yr	0.00e+00 lbs/yr
Hexane	1.60e-01 lbs/yr	0.00e+00 lbs/yr
Methanol	2.90e+02 lbs/yr	0.00e+00 lbs/yr
Styrene	1.20e+01 lbs/yr	0.00e+00 lbs/yr
Toluene	6.00e+00 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Exposure Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Vinyl acetate	8.30e-06	0.00e+00	-	-
Hydroquinone	6.80e-08	0.00e+00	-	-
Ethyl acrylate	4.08e-08	0.00e+00	-	-
Acetaldehyde	8.17e-07	0.00e+00	-	-
Formaldehyde	4.08e-06	0.00e+00	9.40e-02	4.90e-02
Glycol ethers	2.04e-05	0.00e+00	9.30e-02	-
Hexane	1.09e-08	0.00e+00	-	-
Methanol	1.97e-05	0.00e+00	2.80e+01	-
Styrene	8.17e-07	0.00e+00	2.10e+01	-
Toluene	4.08e-07	0.00e+00	3.70e+01	1.51e+01

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Vinyl acetate	6.64e-07	2.00e-01	1.47e-07
Hydroquinone	5.44e-09	1.40e-01	1.72e-09
Acetaldehyde	6.53e-08	9.00e-03	3.22e-07
Glycol ethers	1.63e-06	2.00e-02	3.62e-06
Hexane	8.71e-10	2.00e-01	1.93e-10
Methanol	1.58e-06	1.75e+00	4.00e-08
Styrene	6.53e-08	1.00e+00	2.90e-09
Toluene	3.27e-08	4.00e-01	3.62e-09
	Hazard Index (HI)		4.14e-06

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Vinyl acetate	0.00e+00	2.00e-01	0.00e+00
Hydroquinone	0.00e+00	1.40e-01	0.00e+00
Acetaldehyde	0.00e+00	9.00e-03	0.00e+00
Glycol ethers	0.00e+00	2.00e-02	0.00e+00
Hexane	0.00e+00	2.00e-01	0.00e+00
Methanol	0.00e+00	1.75e+00	0.00e+00
Styrene	0.00e+00	1.00e+00	0.00e+00
Toluene	0.00e+00	4.00e-01	0.00e+00
	Hazard Index (HI)		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)
Vinyl acetate	6.64e-07	2.00e-01	1.47e-07
Hydroquinone	5.44e-09	1.40e-01	1.72e-09
Acetaldehyde	6.53e-08	9.00e-03	3.22e-07
Glycol ethers	1.63e-06	2.00e-02	3.62e-06
Hexane	8.71e-10	2.00e-01	1.93e-10
Methanol	1.58e-06	1.75e+00	4.00e-08
Styrene	6.53e-08	1.00e+00	2.90e-09
Toluene	3.27e-08	4.00e-01	3.62e-09
	Hazard Index (HI)		4.14e-06

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Receptor - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethyl acrylate	3.27e-09	1.37e-02	2.83e-13
Acetaldehyde	6.53e-08	2.20e-03	9.10e-13
Formaldehyde	3.27e-07	1.30e-02	2.69e-11
	Total Risk		2.81e-11

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethyl acrylate	0.00e+00	1.37e-02	0.00e+00
Acetaldehyde	0.00e+00	2.20e-03	0.00e+00
Formaldehyde	0.00e+00	1.30e-02	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethyl acrylate	3.27e-09	1.37e-02	2.83e-13
Acetaldehyde	6.53e-08	2.20e-03	9.10e-13
Formaldehyde	3.27e-07	1.30e-02	2.69e-11
	Total Risk		2.81e-11

Air Emissions Risk Screening Tool Based on SCREEN3

Type of model run: Facility-specific

Facility Information
ID Number: 097190ADC
Name: Victory Memorial Hospital
Street Address:
City: Waukegan State: IL

For Stack Emissions
Stack Height: 18.7 m
Stack Diameter: 3.05 m
Stack Exit Gas Velocity: 0.939 m/sec
Stack Exit Temperature: 450 K
Ambient Air Temperature: 294 K

Surrounding Land Use: Urban
Terrain Height: 0 m
Distance to Receptor: 1879 m
Meteorological Classification: Full
Downwash? No

Exposure Information
Recreational Exposure - Child Soccer Player
Inhalation Rate: 1.9 cu m/hr
Hours of Exposure: 2
Days of Exposure: 50
Years of Exposure: 10
Body Weight: 41.1

Chemical	Stack Emission Rate	Fugitive Emission Rate
Ethylene oxide	2.00e-01 lbs/yr	0.00e+00 lbs/yr

Results

Acute Benchmark Comparison

Depicted below are the results of a comparison of the predicted air concentration with two risk-based concentrations: the Acute Reference Exposure Levels (RELs) developed by the State of California Office of Environmental Health Hazard Assessment (OEHHA) and the Acute Minimal Risk Levels (MRLs) developed by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). If the exposure concentrations are at or above these numbers, there is a possibility that individuals may be at risk and a more detailed risk assessment should be performed.

Recreational Benchmarks

Chemical Name	1-hr Maximum Stack Conc. (mg/cu m)	1-hr Maximum Fugitive Conc. (mg/cu m)	OEHHA Acute REL (mg/cu m)	ATSDR Acute MRL (mg/cu m)
Ethylene oxide	4.64e-08	0.00e+00	-	-

Non-Cancer Risks

Depicted below are the results calculated for non-cancer risks. The results are displayed as a Hazard Quotient (HQ). An HQ, quite simply, is the ratio of the specified air concentration predicted (or measured, or derived in some manner) divided by the Reference Concentration (RfC) or Inhalation RfD developed by the U.S. EPA. Adjustments to the calculation are made to account for any differences between the values selected by the user for inhalation rate, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the RfC. The Hazard Index (HI) is the sum of the HQs. HQs or an HI that equal or exceed 1 indicate a situation of potential health concern.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Reference Conc. (mg/cu m)	Hazard Quotient (unitless)

Non-Cancer Risks for Residential exposures do not exist for the selected chemical(s).

Cancer Risks

Depicted below are the estimated cancer risks. Cancer risk is expressed as the probability of contracting cancer from exposures that occur over a lifetime. Generally, if the risk is greater than 1E-04, then a more detailed risk assessment should be performed.

For the inhalation pathway, a cancer risk is calculated as the product of the air concentration and the Unit Risk Factor. A Unit Risk Factor is in units of 1/concentration, such as 1/(mg/ cu m), so that a multiplication of this unit risk times a given air concentration, in appropriate units, will equal cancer risk. This unit risk is specifically defined as the cancer risk given a lifetime of exposure at the specified concentration. Adjustments to the calculations are made to account for any differences between the values selected by the user for inhalation rate, years of exposure, days per year exposure, and body weight and the values used by EPA for these parameters in the derivation of the unit risk factors.

Recreational Exposure - Child Soccer Player

Stack Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	3.71e-09	1.00e-01	2.35e-12
	Total Risk		2.35e-12

Fugitive Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	0.00e+00	1.00e-01	0.00e+00
	Total Risk		0.00e+00

Combined Emissions

Chemical Name	Annual Average Conc. (mg/cu m)	Unit Risk (1/(mg/cu m))	Risk (unitless)
Ethylene oxide	3.71e-09	1.00e-01	2.35e-12
	Total Risk		2.35e-12

APPENDIX D

EMISSION RATE ESTIMATES AND STACK PARAMETERS FOR MIDWEST GENERATION (WAUKEGAN STATION), ABBOTT LABORATORIES, AND OUTBOARD MARINE/BOMBARDIER

Abbott Boiler 7 Emissions

1.20E-01 grams/yr

Dioxin and Dioxin-like Compounds

logical order	CDD/CDF Cogener	Percent	Emissions (grams/yr)	TRI Reporting number	I TEF	I TEq	WHO TEF	WHO TEq
1	2,3,7,8-TCDD	0.3	**0.00036**	17	1	0.00036	1	0.00036
2	1,2,3,7,8-PeCDD	0	**0.00000**	15	0.5	0	1	0
3	1,2,3,4,7,8-HxCDD	0	**0.00000**	7	0.1	0	0.1	0
4	1,2,3,6,7,8-HxCDD	0.23	**0.00028**	8	0.1	0.0000276	0.1	0.0000276
5	1,2,3,7,8,9-HxCDD	0.23	**0.00028**	9	0.1	0.0000276	0.1	0.0000276
6	1,2,3,4,6,7,8-HpCDD	12.7	**0.01524**	10	0.01	0.0001524	0.01	0.0001524
7	1,2,3,4,6,7,8,9-OCDD	30.36	**0.03643**	12	0.001	0.000036432	0.0001	3.6432E-06
8	2,3,7,8-TCDF	6.4	**0.00768**	16	0.1	0.000768	0.1	0.000768
9	1,2,3,7,8-PeCDF	0.41	**0.00049**	13	0.05	0.0000246	0.05	0.0000246
10	2,3,4,7,8-PeCDF	4.34	**0.00521**	14	0.5	0.002604	0.5	0.002604
11	1,2,3,4,7,8-HxCDF	5.75	**0.00690**	3	0.1	0.00069	0.1	0.00069
12	1,2,3,6,7,8-HxCDF	0.82	**0.00098**	4	0.1	0.0000984	0.1	0.0000984
13	1,2,3,7,8,9-HxCDF	0.76	**0.00091**	5	0.1	0.0000912	0.1	0.0000912
14	2,3,4,6,7,8-HxCDF	2.52	**0.00302**	6	0.1	0.0003024	0.1	0.0003024
15	1,2,3,4,6,7,8-HpCDF	20.79	**0.02495**	1	0.01	0.00024948	0.01	0.00024948
16	1,2,3,4,7,8,9-HpCDF	5.11	**0.00613**	2	0.01	0.00006132	0.01	0.00006132
17	1,2,3,4,6,7,8,9-OCDF	9.28	**0.01114**	11	0.001	0.000011136	0.0001	1.1136E-06
						0.005504568	grams/yr	0.005461757
	totals	100	0.12			5.50E-03	grams/yr	5.46E-03
	From TRI Form R for Abbott					1.21355E-05	lbs/yr	1.20411E-05
						0.0000121355	lbs/yr	0.0000120411

APPENDIX D

EMISSION RATE ESTIMATES AND STACK PARAMETERS FOR MIDWEST GENERATION (WAUKEGAN STATION), ABBOTT LABORATORIES, AND OUTBOARD MARINE/BOMBARDIER

Abbott Boiler 7 Emissions

1.20E-01 grams/yr

Dioxin and Dioxin-like Compounds

logical order	CDD/CDF Cogener	Percent	Emissions (grams/yr)	TRI Reporting number	I TEF	I TEq	WHO TEF	WHO TEq
1	2,3,7,8-TCDD	0.3	**0.00036**	17	1	0.00036	1	0.00036
2	1,2,3,7,8-PeCDD	0	**0.00000**	15	0.5	0	1	0
3	1,2,3,4,7,8-HxCDD	0	**0.00000**	7	0.1	0	0.1	0
4	1,2,3,6,7,8-HxCDD	0.23	**0.00028**	8	0.1	0.0000276	0.1	0.0000276
5	1,2,3,7,8,9-HxCDD	0.23	**0.00028**	9	0.1	0.0000276	0.1	0.0000276
6	1,2,3,4,6,7,8-HpCDD	12.7	**0.01524**	10	0.01	0.0001524	0.01	0.0001524
7	1,2,3,4,6,7,8,9-OCDD	30.36	**0.03643**	12	0.001	0.000036432	0.0001	3.6432E-06
8	2,3,7,8-TCDF	6.4	**0.00768**	16	0.1	0.000768	0.1	0.000768
9	1,2,3,7,8-PeCDF	0.41	**0.00049**	13	0.05	0.0000246	0.05	0.0000246
10	2,3,4,7,8-PeCDF	4.34	**0.00521**	14	0.5	0.002604	0.5	0.002604
11	1,2,3,4,7,8-HxCDF	5.75	**0.00690**	3	0.1	0.00069	0.1	0.00069
12	1,2,3,6,7,8-HxCDF	0.82	**0.00098**	4	0.1	0.0000984	0.1	0.0000984
13	1,2,3,7,8,9-HxCDF	0.76	**0.00091**	5	0.1	0.0000912	0.1	0.0000912
14	2,3,4,6,7,8-HxCDF	2.52	**0.00302**	6	0.1	0.0003024	0.1	0.0003024
15	1,2,3,4,6,7,8-HpCDF	20.79	**0.02495**	1	0.01	0.00024948	0.01	0.00024948
16	1,2,3,4,7,8,9-HpCDF	5.11	**0.00613**	2	0.01	0.00006132	0.01	0.00006132
17	1,2,3,4,6,7,8,9-OCDF	9.28	**0.01114**	11	0.001	0.000011136	0.0001	1.1136E-06
						0.005504568	grams/yr	0.005461757
	totals	100	0.12			5.50E-03	grams/yr	5.46E-03
	From TRI Form R for Abbott					1.21355E-05	lbs/yr	1.20411E-05
						0.0000121355	lbs/yr	0.0000120411

Abbott Revised HAPs & Emission Source Parameters

Source	Hg Comp. lb/yr	Dioxins gram/yr	MeCl tpy	H ft	T F	V acfm	D ft
Boiler 7	15	0.12		101	350	45000	5.5
S-32 Carbon Bed			50	25	70	4000	2.17

Source	Hg Comp. g/s	Dioxins g/s	MeCl g/s	H m	T K	V m/s	D m
Boiler 7	0.000216	3.81E-09		30.785	449.817	9.622	1.676
S-32 Carbon Bed			1.438356	7.620	294.261	5.494	0.661

NOTE:
Use Boilers parameters for Hg, Dioxin, and HCl
Use Carbon Bed parameters for MeCl and other 2 Haps from IEPA inventory

OMC/Bombardier Revised HAPs & Emission Source Parameters																Compounds		Glycol			M & P				Dibutyl		Ethyl-					Formal-	1,3 But-		Acet-	Propion-			2,2,4 Tri-	Croton-
					STACK	HS	TS	FLOW	DS	HS	TS	VEL		DS	Manganese	Chromium	Nickel	Ethers	O-Xylene	P-Xylene	Xylene	Xylene	MEK	Toluene	Phthlate	MIBK	benzene	DEHP	Methanol	Hexane	Benzene	dehyde	adiene	Cumene	aldehyde	aldehyde	Acrolien	MTBE	metylpentane	aldehyde
	Source	T5 Page	Plant	Mode	ID	FT	F	ACFM	FT	M	K	M/S		M	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr	Max. lbs/hr
SO SRCPARAM OMC5	Polish/Shot Line A	168	2		CC24	34.5	70	24000	3.3	10.52	294.3	14.25		1.01	0.012	0.003	0.004																							
SO SRCPARAM OMC6	Polish/Shot Line B	193	2		CC23	34.5	70	24000	3.3	10.52	294.3	14.25		1.01	0.010	0.002	0.003																							
SO SRCPARAM OMC7	Lathe/Rotoclone	218	2		E17	33.5	70	4000	1	10.21	294.3	25.87		0.30	0.007	0.002	0.003																							
SO SRCPARAM OMC8	Lathe/Hundte	243	2		D17	35	70	4200	1.57	10.67	294.3	11.02		0.48	0.007	0.002	0.003																							
SO SRCPARAM OMC10	Production Painting	285	2	Fuel	HH12-2					10.44	294.26	12.07		0.91		0.009		1.65				2.73	8.07																	
SO SRCPARAM OMC11	Exhibits Painting	329	2	Paint	C17/C19	35	70	9600	2.83	10.67	294.3	7.75		0.86								0.215	0.19	0.67	0.215	1.065	0.215	0.21	0.19											
SO SRCPARAM OMC12	Test Panel Painting	368	1	Paint	42	36	70	9000	2	10.97	294.3	14.55		0.61		0.008		0.275				0.455	1.569																	
SO SRCPARAM OMC13	Prototype Painting	404	1	Paint	321	50	70	10000	2	15.24	294.3	16.17		0.61		0.0031		0.275				0.455	1.569																	
SO SRCPARAM OMC24	E-coating	533	1	Fuel	B10	30			2.33	9.14	505.0	18.12		0.71				1.72																						
SO SRCPARAM OMC28	Vertical Drive Test	609	1		DD13-1	33.5			3	10.21	300.0	0.10		0.91					0.0069	0.0083				0.0228			0.0034			0.0039	0.0062	0.0033	0.0075		0.0012	0.0001	0.0003		0.0088	0.0001
SO SRCPARAM OMC9	*Shot/Wheelabrator*	*268*	*2*		*?*	*49.5*	*70*	*3150*	*1.33*	*15.09*	*294.3*	*11.52*		*0.41*	*0.0032*	*0.0007*	*0.0005*																							
SO SRCPARAM OMC25	Indoor Endurance	568	1		101					17.98	300.0	9.50		0.69					1.3699		3.7215		0.0114	3.2648			1.5982			0.8676	0.4110	0.3881	0.1142	0.0913	0.0685	0.0228	0.0228	8.3105		
SO SRCPARAM OMC27	Engine Development	588	1		104-106,109,110,112,113,115					10.00	294.0	0.10		0.10					0.2740		0.7306		0.0023	0.6393			0.3196			0.1598	0.0685	0.0685	0.0228	0.0183	0.0137	0.0046	0.0046	1.6210		
SO SRCPARAM OMC29	Emissions Cert. Test	628	1		REF1-REF5					10.00	305.4	0.10		0.10					0.0594		0.1598		0.0023	0.1416			0.0685			0.0365	0.0183	0.0160	0.0046	0.0046	0.0023	0.0023	0.0023	0.3607		
SO SRCPARAM OMC30	Outdoor Endurance	648	1		MB1-MB16					10.00	300.0	0.10		0.10					3.2313		8.7755		0.0272	7.7211			3.7755			2.0408	0.9524	0.9184	0.3061	0.2041	0.1701	0.0680	0.0680	19.5918		
	HAP TOTAL														0.039	0.0298	0.0135	3.9200	4.9414	0.0083	13.3874	3.8550	11.4412	12.4596	0.2150	1.0650	5.9802	0.2100	0.1900	3.1086	1.4563	1.3943	0.4552	0.3182	0.2557	0.0978	0.0980	29.8841	0.0088	0.0001
	ESTIMATED ANNUAL T5 lbs/yr														343.360	260.916	117.880	34339.200	43286.566	72.708	117273.469	33769.800	100224.847	109145.663	1883.400	9329.400	52386.653	1839.600	1664.400	27231.715	12757.169	12213.806	3987.333	2787.755	2240.308	856.794	858.546	261784.490	77.088	0.876
	IEPA HAPS INVENTORY lbs/yr																	2360.000			41340.000		80.000	26560.000			11260.000			6100.000	2880.000	2680.000	860.000	620.000	500.000	160.000	160.000	58260.000		
Gray shaded stack parameters are estimated or defaults due to lack of data.																																								
The below sources were used to calculate the hourly emissions used to get the G/S emission rates.																																								
															Max. tpy	Max. tpy	Max. tpy		Max. tpy		Max. tpy		Max. tpy	Max. tpy			Max. tpy			Max. tpy	Max. tpy	Max. tpy	Max. tpy	Max. tpy	Max. tpy	Max. tpy	Max. tpy	Max. tpy		
SO SRCPARAM OMC9	Shot/Wheelabrator	268	2		?	49.5	70	3150	1.33	15.09	294.3	11.52		0.41	0.014	0.003	0.002																							
SO SRCPARAM OMC25	Indoor Endurance	568	1		101	59		7433	2.25	17.98		9.50		0.69					6		16.3		0.05	14.3			7			3.8	1.8	1.7	0.5	0.4	0.3	0.1	0.1	36.4		
SO SRCPARAM OMC27	Engine Development	588	1		104-106,109,110,112,113,115														1.2		3.2		0.01	2.8			1.4			0.7	0.3	0.3	0.1	0.08	0.06	0.02	0.02	7.1		
SO SRCPARAM OMC29	Emissions Cert. Test	628	1		REF1-REF5		90				305.4								0.26		0.7		0.01	0.62			0.3			0.16	0.08	0.07	0.02	0.02	0.01	0.01	0.01	1.58		
SO SRCPARAM OMC30	Outdoor Endurance	648	1		MB1-MB16														9.5		25.8		0.08	22.7			11.1			6	2.8	2.7	0.9	0.6	0.5	0.2	0.2	57.6		
METRIC Units																Compounds		Glycol			M & P				Dibutyl		Ethyl-					Formal-	1,3 But-		Acet-	Propion-			2,2,4 Tri-	Croton-
					STACK	HS	TS	FLOW	DS	HS	TS	VEL	Wghtd TS	DS	Manganese	Chromium	Nickel	Ethers	O-Xylene	P-Xylene	Xylene	Xylene	MEK	Toluene	Phthlate	MIBK	benzene	DEHP	Methanol	Hexane	Benzene	dehyde	adiene	Cumene	aldehyde	aldehyde	Acrolien	MTBE	metylpentane	aldehyde
	Source	T5 Page	Plant	Mode	ID	FT	F	ACFM	FT	M	K	M/S	K	M	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
SO SRCPARAM OMC5	Polish/Shot Line A	168	2		CC24	34.5	70	24000	3.3	10.52	294.3	14.25	4194.60	1.01	0.001512	0.000378	0.000504																							
SO SRCPARAM OMC6	Polish/Shot Line B	193	2		CC23	34.5	70	24000	3.3	10.52	294.3	14.25	4194.60	1.01	0.00126	0.000252	0.000378																							
SO SRCPARAM OMC7	Lathe/Rotoclone	218	2		E17	33.5	70	4000	1	10.21	294.3	25.87	7613.19	0.30	0.000882	0.000252	0.000378																							
SO SRCPARAM OMC8	Lathe/Hundte	243	2		D17	35	70	4200	1.57	10.67	294.3	11.02	3243.07	0.48	0.000882	0.000252	0.000378																							
SO SRCPARAM OMC9	Shot/Wheelabrator	268	2		?	49.5	70	3150	1.33	15.09	294.3	11.52	3389.33	0.41	0.00040274	8.63E-05	5.753E-05																							
SO SRCPARAM OMC10	Production Painting	285	2	Fuel	HH12-2					10.44	294.26	12.07	3552.82	0.91		0.001134		0.2079				0.34398	1.01682																	
SO SRCPARAM OMC11	Exhibits Painting	329	2	Paint	C17/C19	35	70	9600	2.83	10.67	294.3	7.75	2281.42	0.86								0.02709	0.02394	0.08442	0.02709	0.13419	0.02709	0.02646	0.02394											
SINGLE SOURCE OMC	**PLANT 2**									**11.16**		**13.82**	**294.26**	**0.71**	**0.0049**	**0.0024**	**0.0017**	**0.2079**	**0.0000**	**0.0000**	**0.0000**	**0.3711**	**1.0408**	**0.0844**	**0.0271**	**0.1342**	**0.0271**	**0.0265**	**0.0239**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
UTM E (m)	**432500**																																							
UTM N (m)	**4690961**																																							
SO SRCPARAM OMC12	Test Panel Painting	368	1	Paint	42	36	70	9000	2	10.97	294.3	14.55	4282.42	0.61		0.001008		0.03465				0.05733	0.197694																	
SO SRCPARAM OMC13	Prototype Painting	404	1	Paint	321	50	70	10000	2	15.24	294.3	16.17	4758.24	0.61		0.0003906		0.03465				0.05733	0.197694																	
SO SRCPARAM OMC24	E-coating	533	1	Fuel	B10	30			2.33	9.14	505.0	18.12	9150.60	0.71				0.21672																						
SO SRCPARAM OMC28	Vertical Drive Test	609	1		DD13-1	33.5			3	10.21	300.0	0.10	30.00	0.91					0.0008694	0.0010458				0.0028728			0.0004284			0.0004914	0.0007812	0.0004158	0.000945		0.0001512	0.0000126	0.0000378		0.0011088	0.0000126
SO SRCPARAM OMC25	Indoor Endurance	568	1		101					17.98	300.0	9.50	2850.00	0.69					0.1726027		0.4689041		0.0014384	0.4113699			0.2013699			0.1093151	0.0517808	0.0489041	0.0143836	0.0115068	0.0086301	0.0028767	0.0028767	1.0471233		
SO SRCPARAM OMC27	Engine Development	588	1		104-106,109,110,112,113,115					10.00	294.0	0.10	29.40	0.10					0.0345205		0.0920548		0.0002877	0.0805479			0.040274			0.020137	0.0086301	0.0086301	0.0028767	0.0023014	0.001726	0.0005753	0.0005753	0.2042466		
SO SRCPARAM OMC29	Emissions Cert. Test	628	1		REF1-REF5					10.00	305.4	0.10	30.54	0.10					0.0074795		0.020137		0.0002877	0.0178356			0.0086301			0.0046027	0.0023014	0.0020137	0.0005753	0.0005753	0.0002877	0.0002877	0.0002877	0.0454521		
SO SRCPARAM OMC30	Outdoor Endurance	648	1		MB1-MB16					10.00	300.0	0.10	30.00	0.10					0.4071429		1.1057143		0.0034286	0.9728571			0.4757143			0.2571429	0.12	0.1157143	0.0385714	0.0257143	0.0214286	0.0085714	0.0085714	2.4685714		
SINGLE SOURCE OMC	**PLANT 1**									**11.69**		**7.34**	**360.23**	**0.48**	**0.0000**	**0.0014**	**0.0000**	**0.2860**	**0.6226**	**0.0010**	**1.6868**	**0.1147**	**0.4008**	**1.4855**	**0.0000**	**0.0000**	**0.7264**	**0.0000**	**0.0000**	**0.3917**	**0.1835**	**0.1757**	**0.0574**	**0.0401**	**0.0322**	**0.0123**	**0.0123**	**3.7654**	**0.0011**	**0.0000**
UTM E (m)	**432538**																																							
UTM N (m)	**4690261**																																							
	HAP TOTAL														0.010	0.0075	0.0034	0.9878	1.2452	0.0021	3.3736	0.9715	2.8832	3.1398	0.0542	0.2684	1.5070	0.0529	0.0479	0.7834	0.3670	0.3514	0.1147	0.0802	0.0644	0.0246	0.0247	7.5308	0.0022	0.0000
Gray shaded stack parameters are estimated or defaults due to lack of data.																																								

Waukegan Generating Station

8.00E+06 tons bituminous Montana coal burned annually at facility

Dioxin and Dioxin-like Compounds

CDD/CDF Cogener	E.F (ng/kg coal)	Emissions (grams/yr)	I TEF	I TEq	WHO TEF	WHO TEq
2,3,7,8-TCDD	0.005	**0.03629**	1	0.0362878	1	0.036288
1,2,3,7,8-PeCDD	0	**0**	0.5	0	1	0
1,2,3,4,7,8-HxCDD	0	**0**	0.1	0	0.1	0
1,2,3,6,7,8-HxCDD	0.004	**0.02903**	0.1	0.002903	0.1	0.002903
1,2,3,7,8,9-HxCDD	0.004	**0.02903**	0.1	0.002903	0.1	0.002903
1,2,3,4,6,7,8-HpCDD	0.216	**1.56763**	0.01	0.0156763	0.01	0.015676
1,2,3,4,6,7,8,9-OCDD	0.517	**3.75215**	0.001	0.0037522	0.0001	0.000375
2,3,7,8-TCDF	0.109	**0.79107**	0.1	0.0791073	0.1	0.079107
1,2,3,7,8-PeCDF	0.007	**0.05080**	0.05	0.0025401	0.05	0.00254
2,3,4,7,8-PeCDF	0.074	**0.53706**	0.5	0.2685294	0.5	0.268529
1,2,3,4,7,8-HxCDF	0.098	**0.71124**	0.1	0.071124	0.1	0.071124
1,2,3,6,7,8-HxCDF	0.014	**0.10161**	0.1	0.0101606	0.1	0.010161
1,2,3,7,8,9-HxCDF	0.013	**0.09435**	0.1	0.0094348	0.1	0.009435
2,3,4,6,7,8-HxCDF	0.043	**0.31207**	0.1	0.0312075	0.1	0.031207
1,2,3,4,6,7,8-HpCDF	0.354	**2.56917**	0.01	0.0256917	0.01	0.025692
1,2,3,4,7,8,9-HpCDF	0.087	**0.63141**	0.01	0.0063141	0.01	0.006314
1,2,3,4,6,7,8,9-OCDF	0.158	**1.14669**	0.001	0.0011467	0.0001	0.000115
				0.5667786		0.56237
total (not a sum)	1.71	**12.4**				

From U.S. EPA TRI Guidance for Reporting Dioxin and Dioxin-like Compounds

---

Mercury Emissions

Boiler #6

burns ton/mnth coal	54,888	from T5 application
coal contains ppm Hg	0.09	from U.S. EPA TRI reporting guidance for Electrical Generating Facilities
Percent Hg released to air	99.96	from U.S. EPA TRI reporting guidance for Hg and Hg Compounds
lb Hg released/yr	118.51	

Boiler #7

burns ton/mnth coal	136,076	from T5 application
coal contains ppm Hg	0.09	from U.S. EPA TRI reporting guidance for Electrical Generating Facilities
Percent Hg released to air	86.54	from U.S. EPA TRI reporting guidance for Hg and Hg Compounds
lb Hg released/yr	254.36	

Boiler #8

burns ton/mnth coal	137,233	from T5 application
coal contains ppm Hg	0.09	from U.S. EPA TRI reporting guidance for Electrical Generating Facilities
Percent Hg released to air	86.54	from U.S. EPA TRI reporting guidance for Hg and Hg Compounds
lb Hg released/yr	256.52	

Total Hg/yr from plant **629.40**

PAC Emissions

total PAC (lb)/ ton coal 1.12E-06 from U.S. EPA TRI reporting guidance for PACs

lb PAC/yr 8.96

Model total PACs at 9.2 lbs/yr (to include Benzo(g,h,i)perylene at 0.22 lbs/yr)

The following table was used to estimate individual PACs, model total PACs at 9.2 lbs/yr

PACs Speciated in AP-42 Section for Bituminous Coal Combustion, no speciation data in TRI Guidance Document

compound	CAS #	E.F. (lb/ton)	emissions (lb/yr)	
Benzo(a)anthracene	56-66-3	8.0E-08	0.64	from AP-42, Section 1.1, Table 1.1-13, 9/98
Benzo(a)pyrene	50-32-8	3.8E-08	0.30	from AP-42, Section 1.1, Table 1.1-13, 9/98
Benzo(g,h,i)perylene*		2.7E-08	0.22	from AP-42, Section 1.1, Table 1.1-13, 9/98
Benzo(a)phenanthrene	218-01-9	1.0E-07	0.80	from AP-42, Section 1.1, Table 1.1-13, 9/98
Benzo(j,k)fluorene	206-44-0	7.1E-07	5.68	from AP-42, Section 1.1, Table 1.1-13, 9/98
Ideno(1,2,3-cd)pyrene	193-39-5	6.1E-08	0.49	from AP-42, Section 1.1, Table 1.1-13, 9/98

* Benzo(g,h,i)perylene is not a PAC, but is listed separately as a PBT